INTERNATIONAL
MARINE ENGINEERING

Published Monthly by ALDRICH PUBLISHING CO.

6 EAST 39th STREET, NEW YORK — 8 BOUVERIE ST., LONDON, E. C.

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Vol. XXIII — OCTOBER, 1918 — No. 10

Removal Notice

BEGINNING with the first of October, the Government will occupy the entire space of the Printing Crafts Building. This has compelled a change in home for MARINE ENGINEERING. We have moved—moved to larger quarters—and happily announce our new address as 6 East 39th Street, New York, where we shall be pleased to receive our contributors and subscribers and advertisers at any time.

The Fourth Liberty Loan

THE Government has opened its Fourth Liberty Loan campaign. The money is needed to carry forward the work of the war. It is of vital interest to every man, woman and child that this issue be taken up with a readiness of response that will of itself be our answer to the enemy peace moves recently launched. No patriot living wants a peace at this time with the enemy country still uninvaded and the might of the enemy will still practically unbroken. Kaiserism must be made a limp and lifeless thing, stripped of all power for harm for all future time, before peace can decently be considered by the allied nations. Every man among us well realizes this. We are in the war to win, and to win through sheer power of arms. The way to bring this about, for many of us, is to give freely of our own resources in time and money to make this loan a whirlwind success. The Government will do the rest. Your bit and my bit and the other fellow's bit all added to the sum total will bring victory in the field. Let us snap up this loan as no other loan ever was snapped up.

Hot Bulb Engines

THE speed at which the majority of hot bulb engines operate is a good deal too high for the most efficient speed of the propeller, but usually the other advantages of the oil engine are sufficient to permit this loss of efficiency to be neglected. For instance, with fairly large hot bulb engines, say from 100 to 500 horsepower, fitted to such craft as tugs, barges and large auxiliary trading vessels, the speed is generally between 220 revolutions per minute for the larger engines and 350 revolutions per minute for the smaller sets. A much more satisfactory speed, especially for tugs and for large auxiliaries, would be in the neighborhood of 100 revolutions per minute, and it is therefore of interest to note that in America considerable progress is being made in the employment of reduction gears in connection with hot bulb engines. With some of the craft now under construction, carrying up to 3,000 tons of cargo, reduction gears in connection with 320 horsepower hot bulb engines are being fitted, reducing the speed from about 250 to under 80 to 90 revolutions per minute. A tug was recently designed 66 feet in length, with a beam of 17 feet 8 inches, fitted with a 100 brake horse-power hot bulb engine, running at 340 revolutions per minute, but driving the propeller at 93 revolutions per minute through a turbo reduction gear. By this means a propeller 4 feet 6 inches in diameter could be fitted, and it is stated that the loss in the gear is not more than 2 percent.

Liberty Loan Clubs

IN connection with the Fourth Liberty Loan, the Government, in order to build up united action in the campaign, has proposed a scheme for the consideration of industrial owners and managers. It is suggested that in every plant there be organized a Liberty Loan Club, each having its leader and corps of speakers, with meetings held daily during the progress of the campaign—all for the purpose of engendering interest and activity in the loan.

The bonds must be sold. With certain picked employees circulating through the noon gatherings selling bonds, and with a few well-chosen speakers on the platform pointing out the great and urgent need of success, with an interpreter or two for the benefit of workmen who require interpreters, such a method for aiding the Government in placing this issue of bonds ought to be eminently fruitful. At any rate, it should be seriously considered by manufacturers and owners everywhere as a plan well worth trying.

But BUY BONDS!

Americans as Shipbuilders

RECENTLY a delegation from England representing the press visited our shores and shipyards. One of their ports of call was the Hog Island yard. A guide escorted the gentlemen proudly through. He said:

"From a swamp, in September, 1917, visited only by stray cows, Hog Island to-day, in a period of less than a year, has more ways for big ships than all America possessed before the war. By December, 1918, it is hoped, the fifty ships which you see will have been completed, launched, loaded and dispatched with full cargoes to Europe. Fifty others will then be on the stocks."

The delegation stood frankly amazed. Nothing in all the stupendous war activities of the United States had been more impressive. A correspondent representing the *Manchester Guardian* spoke later in the columns of his paper, to wit, as follows:

"Hog Island is a modern miracle. The first sight of it to a British sailor makes him doubt the evidence of his

eyes. Others with me had that same feeling. We knew the Clyde, the Tyne, Belfast and the Mersey, and had been proud of their individual and collective achievements.

"But Hog Island was something outside our experience, beyond our imagination. We gazed with wondering eyes at its mighty framework of girders, its grand array of cradles and slips. We counted the ships being built in a row side by side, and found that they numbered fifty. That was what we could scarcely credit. 'Small ships!' one man, selfishly patriotic, suggested. 'Each of 7,500 to 8,000 tons,' replied our guide. Multitudes of men were busy on these ships working at record-breaking speed. We were told that an 'honor system' had been inaugurated. Gold and silver medals were awarded for meritorious services, and encouragement was given to the men to develop ideas that would increase tonnage and would inspire their fellow workers to greater efforts."

We shall make no comment. The thing tells its own story. We—— Wait! Just one word. America must strive to hold this supremacy, so frankly acknowledged us by our cousins across the water, for all time to come.

It can be done.

Advancing Foreign Trade

THE position which this country is destined to occupy in the markets of the world has been anticipated by a small body of men who have grouped themselves together into an organization known as the Allied Industries Corporation. The general plans laid down have been formulated to co-operate very closely with the various domestic and foreign trade bureaus of our government in order to work in harmony with the various international foreign trade bureaus of the allied and neutral governments. The corporation plans to conduct the broadest campaigns of education possible and to promote and embody in this campaign principles of good will and international understanding. Thus it hopes to generate an influence that will be made to radiate as widely as possible through a comprehensive system of public education having as its object the fostering of reciprocal international trade relation, establishment of international customs tariffs, standardization of merchandise, the promotion of international legislation affecting trade relations and all international good will and co-operation. Besides investigating international market requirements and international natural resources, it will tabulate international exporters and importers for the service of buyers and consumers and disseminate information on these subjects. Also, international trade markets and patents will be listed and international financial investigations made and kept on file. In other words, the Allied Industrial Corporation aims to become a communicating link for and between the organized trade association of the entire world.

The Allied Club, which will be operated in connection with the association, will afford all the usual and some very unusual club privileges to its members, who will consist of foreign and domestic importers and exporters, brokers, bankers, lawyers, shipping men and commercial agents—a membership that will include all of the proposed branches at London, Paris, Milan, Brussels, Lisbon, Shanghai and Tokio. The home will be located in the Grand Central Palace, New York. Since New York is very definitely the gateway through which American goods must go out to the markets of Europe and South America, just as it is the gateway through which the products of these countries must largely enter the United States, it is proposed to centralize in New York as far as possible the entire flow of foreign trade. Yet it is not the purpose of the organization to narrow the gateway, but to broaden it, very definitely locating a place where buyers from all the world may come together under one roof to facilitate the exchange of commodities and the interchange of ideas.

We feel that this indicates a very important step in the advancement of the foreign trade of the United States. Manufacturers of boilers and boiler accessories should take advantage of this opportunity to build up an international market for their products. Trade extension is always of vital importance, and what with the promised reconstruction period of France alone after the war the Allied Industry Corporation holds out special encouragement and ready inducements for all manufacturers to show a little life.

The American Merchant Fleet

RECENTLY the United States Shipping Board issued a statement to the effect that "within the jurisdiction of the United States Shipping Board at the present time (September 1, 1918) there are 2,185 seagoing vessels, totaling 9,511,915 deadweight tons. Of these, 1,294, totaling 6,596,105 deadweight tons, fly the American flag. Under charter to the Shipping Board and to American citizens there are 891 foreign vessels, totaling 2,915,510 deadweight tons.

"At the time the United States entered the war," the statement continues, "the American merchant marine included approximately only 2,750,000 deadweight tons of seagoing vessels of over 1,500 deadweight tons. This expansion of the fleet within the jurisdiction of the Shipping Board has come about for the most part during the last year."

The fleet lists were as follows on September 1, 1918:

	Number	Deadweight Tons
Requisitioned American ships	449	2,900,525
Ex-German and ex-Austrian ships taken over	100	644,713
New ships owned by Shipping Board	256	1,465,963
Old lake steamers transferred	31	117,800
American merchant ships not yet requisitioned (of over 1,500 deadweight tons)	377	980,459
Dutch steamers requisitioned	81	486,945
Foreign ships chartered to Shipping Board	291	1,208,411
Foreign ships chartered to American citizens	600	1,707,099
Total	2,185	9,511,915

In this swift expansion of our shipping facilities the American people have much of which to be proud. And the end is not yet. It should be a matter of but a very few months now when our total losses due to submarines will be completely overcome.

The Old Sailing Navy

The old sailing navy provided the finest possible mental and physical training, Admiral Lord Charles Beresford is quoted as saying. It taught initiative, presence of mind, accurate observation, habitual defiance of danger, ready resource, and an extraordinary hardihood.

At sea, a man holds his life on the condition that he possesses these qualities. Frequent emergencies are part of the ordinary routine, and the penalty of failing to meet them is inevitable. There is no arguing with a gale of wind.

Owing to unprecedented transportation facilities, your copy of Marine Engineering may reach you late. If you do not get your copy in time please do not be impatient, as it will eventually reach you.

What Ships Mean to Us

President Wilson says:

"We must supply ships by the hundreds out of our shipyards to carry to the other side of the sea—submarines or no submarines—what will every day be needed there; and abundant materials out of our fields and our mines and our factories with which not only to clothe and equip our own forces on land and sea but also to clothe and support our people for whom the gallant fellows under arms can no longer work; to help clothe and equip the armies with which we are co-operating in Europe, and to keep the looms and manufactories there in raw material; coal to keep the fires going in ships at sea and in the furnaces of hundreds of factories across the sea; steel out of which to make arms and ammunition both here and there; rails for worn-out railways back of the fighting fronts; locomotives and rolling stock to take the place of those every day going to pieces; mules, horses, cattle for labor and for military service; everything with which the people of England and France and Italy and Russia have usually supplied themselves, but cannot now afford the men, the materials, or the machinery to make."—*Extract from an address delivered by the President, April* 16, 1917.

What Do Ships Mean to You?

Importance of Large Shipping Fleet is Generally Recognized—Replies to a Question That was Recently Asked—Exporter and Importer Equally Concerned

UPON ocean tonnage the outcome of the war depends. Leaders of the Allied armies and all students of the stupendous conflict in which the greater part of the world is engaged are agreed that the winning of the war depends upon our ability to build ships in required numbers and with sufficient speed to move our armies to the battle lines, maintain them with supplies and the Allies with food.

Upon the United States Shipping Board Emergency Fleet Corporation has devolved the task of supplying this vital need. That our Government officials are keenly alive to this need of ships is shown in the accompanying replies to a question which Chairman E. N. Hurley, of the Shipping Board, has addressed to heads of important departments. The essence of that question was: "WHAT DO SHIPS MEAN TO YOU?"

The replies are wonderfully informative, disclosing, as they do, that there is not an angle of our national life that is not in some way interlocked with shipping. Ships are equally essential to the exporter and to the importer. They are the reliance of the merchant, and farmers are now beginning to realize that without ships to move his grain and produce, these will congest in storehouses and in wharves. They are essential for the food and fuel supply of ourselves and our allies. In the following replies to the query, "What do ships mean to you?" our numerous other needs for ocean tonnage are described.

THE GREAT MERCHANT FLEET WHICH THE SHIPPING BOARD IS CONSTRUCTING MEANS MORE SOLDIERS ON THE FIGHTING FRONT

NEWTON D. BAKER, SECRETARY OF WAR

Each new ship added to our transport service means more American soldiers on the fighting front, more American soldiers in training behind the firing line, more supply workers to make secure the men in camp or trench, more doctors and nurses to care for the wounded, more food and clothing and comforts for our forces abroad, and more vital assistance to our associates there in the war.

Ships, then, are indispensable. Greatly as our people have responded in all phases of war activity, the registration of their power is still determined by ships. We have to bridge 3,000 miles of dangerous water to strike the blows which are required to end the menace of ruthless militarism. Not a bullet can be fired nor a mouth fed by Americans over there unless a rivet has first been driven home here.

They have, indeed, done well. This nation, and all that is free and hopeful in mankind, owes to them a great debt for the earnest manner in which they have rallied to their task. But they will do better, for their souls are in their work, and the human soul, when inspired with visions of noble service, is ever capable of tapping new reserves.

I bid them speed! The army will be ready when the ships are ready.

SHIPS WILL MAKE FOR CONSERVATION

HERBERT HOOVER, FOOD ADMINISTRATOR

No phase of our war programme can be wholly divorced from the shipping situation. This is clearly shown in the case of foodstuffs. It is the shortage of ships which has placed upon us the responsibility of supplying the major share of all foodstuffs needed to maintain the millions of soldiers and civilians who are bearing the brunt of Germany's assaults upon the Western front.

While it entails sacrifices on the part of each of us, our service to those across the sea cannot be regarded as a burden. This is our war just as much as it is theirs. It is not, as in Germany, the war of a few people who control the multitudes. It touches each one of us, and if we are to be victorious each one of us must respond willingly and gladly to every appeal.

Until we are building ships fast enough to supply all war demands, we cannot hope to be relieved of the responsibility for utmost conservation. In this year's crops we very probably see the height of our war-time food production. As we are drawn deeper into the war the situation must become more serious; we must look for a steady degeneration of labor and for reduced production. More and more men will be drawn from accustomed pursuits and enter into direct war activities, as fighters or industrial workers who are supplying the actual sinews of war.

It will become increasingly difficult for us to provide for both the people in Europe and those in America unless by production of ships we can partially open up other sources of supply. So great is the present stringency, these other ports must be eliminated, so far as possible, in order that our few ships may ply at capacity. The effectiveness of each ship taken from the Australian trade, for instance, is trebled, as it could make three round trips from Europe to America while making one from Liverpool to Sidney. Each one diverted from the Argentine doubles in efficiency.

Only if we have more ships can we expect any degree of freedom in manipulating the food supplies of the world so that Europe may be fed without a serious drain upon other countries. We are faced with this tonnage prob-

lem in meeting our present sugar shortage, which is almost wholly due to difficulty of transport and consequent inability to tap stocks in distant sources of supply.

Until the world's tonnage is sufficient to allow freer use of vessels, European supplies must be maintained largely from what can be spared in the United States. The measure of our service may be lightened only in direct ratio to the increase in marine shipping facilities.

SHIPS ARE A VITAL FACTOR IN THE PROBLEM OF MAINTAINING THE NATION'S FUEL SUPPLY

HARRY A. GARFIELD, FUEL ADMINISTRATOR

The Fuel Administration must depend upon ships to supply two great and important sections of our country with coal to keep the people warm and to maintain the constantly increasing industrial activities necessary to the proper prosecution of the war. New England, crowded with great war plants which are turning out a multiplicity of material for our army and navy, must be supplied, to a large extent, by ocean shipments from Southern tidewater ports. The overburdened railways cannot carry more than approximately one-third of New England's coal supply for the year. The remainder demands ships. Without them the wheels of New England's war industries must stop, and New England's people must suffer.

The great section of our country at the northern end of the Great Lakes must likewise depend upon shipping for its coal supply. A great fleet of coal carrying vessels must be in constant service from the lower lake ports to the great coal docks of Lake Superior and Lake Michigan, throughout the open season, if the great Northwest is to secure its winter coal supply. The enormous tonnage of coal demanded by this section cannot be imposed upon the already overburdened railroads. It must move by water, and it must move while the Great Lakes are open for navigation.

All of this means ships, and, as the programme of the Shipping Board continues to be worked out, ships sufficient to carry the coal supply become available. To-day, ships are available to move the constantly increasing coal production. But railroads, ships and coal must grow together, in order that a co-ordinate machinery may be always at hand to keep the nation supplied with fuel.

Fuel is a vital factor in maintaining the nation's shipbuilding and in moving the nation's ships after they are built.

As the armies of the United States in France are enlarged, which enlargement is steadily going on, the materials to support them will have to be increased correspondingly. This means more ships to move the commodities of warfare; it means more materials which have to be manufactured; in means increased railroad capacity to forward raw materials and finished products; it means more factories to produce more materials.

All of which, depending on ships for the final transportation over three thousand miles of ocean, likewise means more coal.

With every additional ship that puts to sea the fuel requirements of the Government are enlarged. Each must be supplied with fuel, either coal or oil. The annual coal requirements budget of the Fuel Administration prepared early in the year included ten million tons of bituminous coal for bunkering of ships.

Later estimates of coal required for bunker purposes for 1918 for steam coal-burning vessels of 500 gross tons and over in ocean service, including American and foreign vessels bunkering in United States ports and excluding warships operated by the navy, bring the total requirements up to 11,790,000 tons. With tonnage for United States naval ships, amounting to 4,269,000 tons, added, the total requirements for this particular class of coal have grown to sixteen million tons. This is the July, 1918, status. The increased requirement is already 100 percent beyond that of last year. As the programme of the Shipping Board gains impetus the responsibilities of the United States Fuel Administration correspondingly enlarge.

SHIPS ARE REGARDED AS VITALLY ESSENTIAL FOR THE GREAT PART WE ARE DESTINED TO PLAY WHEN THE WAR IS WON AND OVER

BERNARD M. BARUCH, CHAIRMAN OF THE WAR INDUSTRIES BOARD

When primitive man's needs became larger than his immediate environment could satisfy, he traveled by land to wider sources of supply. Then he learned to reach new fields by water. Since then he has discovered the means of using a third element—air; but that, as yet, is not usable industrially. The fullness of his life depends upon man's ability to use land and water transportation. His needs in peace were great. In time of war they were multiplied. It is not too much to say that the very life of the nation depends upon her unrestricted access to remote points; it might be even better to say that the very life of the world depends upon it, since the fate of the world is so indissolubly bound up with that of America and her associates.

All of this is expressed in forms of ships. Others will write of what ships mean in relation to men, to material, to food, to fuel, and to trade. I can make plain how much they mean to the governmental agency with which I am connected and which stands as a point of supply for our three great war factors—the War Department, the Navy Department and the Shipping Board. Of equal importance, it is charged with the duty of answering the needs of the civilian population.

In each of these enterprises ships are vital essentials. Over the water routes come to us the nitrates for explosives; manganese for steel; wool for clothing; hides for leather; oil for fuel; rubber for many industrial and medical purposes; cotton, hemp, sisal lumber, minerals of various sorts, and hundreds of other items necessary to prompt and effective conduct of the war.

Ships have helped to lay the foundation of our increasingly great part in the war; ships will help to make certain the great part we are to play in the days to come, for America has emerged from her isolation and her ships will project her friendship and commerce over all the world's waters.

DEVELOPMENT OF TRADE IS DEPENDENT UPON ADEQUATE SUPPLY OF OCEAN TONNAGE

VANCE MC CORMICK, CHAIRMAN OF THE WAR BOARD

The increase in our shipping facilities through construction of a large number of American vessels means for the War Trade Board an opportunity to realize its programme and policies along broader and more positive lines than has heretofore been possible. The functions with which this Board has been entrusted by the President comprise, generally speaking, the war-time regulation of our foreign trade, and the dependence of trade upon shipping is a truism almost too obvious for statement here.

Regulation of our foreign trade, be it noted, and not restriction, is the essential mission of the Board. Unfortunately, however, the world shortage of tonnage and the demand for ships, ships and more ships to transport and maintain our rapidly growing armies in Europe and to supply our co-belligerents have forced the Board to work to a considerable extent along lines of restriction, particularly of imports, deferring the almost equally important function of encouraging and developing our foreign trade under war conditions.

Construction of American ships in large quantities means to us the opportunity to license freely the importation of all required raw materials of foreign origin, where we are now compelled to pick and choose among most, more and less essential supplies and to adjust by painful study and calculation the relative amounts of indispensables which we can and must import.

It means the possibility of free export of American commodities which can be spared under our war programme to overseas destinations to help pay for our great war imports or raw materials and to redress the adverse balance of trade running so strongly against us in many foreign countries. Payment for war imports by commodity exports rather than by our precious and limited stocks of gold is a war measure of prime importance, and it should not be forgotten that exports even of articles to us of non-essential or luxury character which help us to pay for essential imports may, from a war standpoint, be regarded as essential. Adverse balances of trade mean the payment of higher prices for foreign purchases, each penny taken from the exchange value of our dollar in the marts of a foreign land meaning an extra cent added to the price charged us, and adverse balances may in this war be redressed only by shipment of wares. Our enterprising merchants and manufacturers, too, laboring under so many war burdens, are entitled to the openings for export which more ships will give them.

Shipbuilding means to us, *inter alia*, an easier and more grateful task in our negotiations with the neutrals. Not only will our exchange problems, noted above, be lightened when we are no longer compelled to pay such exorbitant prices for the carriage of freights in neutral steamers but can transport them more and more in our own vessels, but our offers of supplies to the neutrals can be more liberal, our calls upon their tonnage less pressing and our relations with them more facile when our great shipbuilding programme comes into full fruition.

So, too, we shall be able to fulfill in far more liberal measure our obligations toward our allies and friendly neighbors in Latin-America, who are dependent on the United States for so many of the commodities required for their well-being or comfort and for whose products the natural market is in such large measure offered by this country. Lack of ships has, during the war, hampered our trade relations with these neighbor nations of the American continent more than we like to contemplate; adequate American tonnage means an opportunity for full development of the great trade possibilities between the peoples of this hemisphere opened up in consequence of the war and of that friendship and understanding which commercial intercourse does so much to promote.

SHIPS WILL HELP TO DESTROY THE MILITARY DESPOTISM OF THE GERMAN KAISER

WM. G. MC ADOO, SECRETARY OF THE TREASURY

We are in the midst of a great war—a war involving the very life and security of America.

Our job is to destroy the military despotism of the German Kaiser and to make the Stars and Stripes wave triumphant over the battlefields in France and thereby reestablish liberty and make safe for the future all the free and independent peoples of the earth. That is our job, and it is the job which America's brave soldiers and sailors cannot do by themselves. They can do it only if the laboring men do their full share, and their full share is to work with all their might and main to turn out quickly the ships which are imperatively needed to carry our gallant soldiers to France and to keep them supplied with food and clothing and arms and ammunition and great guns, so that they may smash the Kaiser quickly and restore peace to a stricken world. Wouldn't it be a crime if we who stay at home should send 1,800,000 of our brave sons to France and then fail to supply the ships and all the munitions of war to enable them not only to save our liberties, our lives and our property, but at the same time to fight successfully the German armies against whom we have sent them! Think of the bloody task we have given our soldiers and sailors and how much better off we are who stay at home, with our lives protected, plenty of work to do, and high wages and nothing to endanger our future unless we fail to back our boys in the armies in France so that they can win the great victory for us.

The one thing most needed now by America's soldiers and sailors is ships, ships, ships. We need ships to carry our gallant boys across the stormy waters of the Atlantic through the hazardous submarine zone; ships to send them guns and bullets and powder and food and clothing, without which they cannot fight. It is the men working in the shipyards upon whom the nation must rely to build these ships in time. What a splendid privilege and opportunity these men have to save democracy! What a fearful calamity to the world it would be if these same men should fail to turn these ships out in time!

AMERICA'S FREEDOM OF THE SEAS DEPENDS UPON HER SHIPPING

WILLIAM C. REDFIELD, SECRETARY OF COMMERCE

I will tell in a few words what shipbuilding work means to the Department of Commerce.

The commerce of the United States is like a man in a strait-jacket. There are certain things he may do; many more he may not do. Freedom, flexibility—these are gone. Commerce has become a weapon of war and is as truly directed to military uses as are armies or artillery. Current commercial thought is of War Trade or War Industries, and the necessities involved in these phrases are like bands about the expansive force of our Commerce holding it tight.

But Commerce is an expansive force, and it cannot be wholly thus restrained. Certain needs of our hundred million people must be supplied, and when reduced to their lowest, still demand a large share of industry to assure that the processes of living shall continue.

Great opportunities lie open to us. In South America and elsewhere men seek the credit and the enterprise of which we are now the greatest reservoir. The Future of America calls to the Present not to neglect it, and Opportunity beckons from many a land with insistent finger. Much that we need is waiting for us.

To the expansive power of Commerce, to the invitation of Opportunity, to the call of the Future upon the action of To-day we have to reply in large measure, "No ships," and, again, "No ships."

To the constricting force of War Trade and War Industries is added the constricting power of No Ships. America fighting for Freedom seeks herself to be free, but has not Liberty at sea for lack of ships.

It is up to the Shipping Board, first, that the army shall have its fill of men and food and munitions, and then, may it come speedily, that there may be freedom of the seas for American Commerce to neutral lands, there to trade with those whose trade we need for the coming Future and from whose trade we are now excluded by No Ships.

The ultimate task, then, beyond the immediate one, is to set the Commerce of America free.

HOPE OF WAR LIES IN OUR SHIPBUILDING INDUSTRY

WILLIAM B. WILSON, SECRETARY OF LABOR

The programme outlined by Edward N. Hurley, Chairman of the United States Shipping Board, means that a very large number of men must be found who are capable of supplying labor. The finding of the right men for these jobs will be the very foundation of the success of this programme, since the building must be prompt. Faithful, steady, conscientious workers must be discovered and turned over to the shipbuilding industry without delay. The hope of the war depends upon this.

Therefore, Mr. Hurley's programme means much to the Department of Labor. Taking the chairman's own figures—that 130 plants in 28 States on both coasts and the Great Lakes are now engaged in shipbuilding, and that more than one-half of these have been developed in two years—it may be seen that the National Department of Labor Employment Service has a tremendous task to perform. The employment exchanges in the various States are working day and night.

Mr. Hurley tells us that he will need for this work 4,000 new men a week until he has placed 400,000 laborers in the shipyards on the coasts and lakes of the country.

To get these men, nearly every industry must contribute, for the shipyards must use the ability of skilled mechanics, artisans, blacksmiths, pattern makers, laborers in erecting, bolting, drilling, riveting, chipping, galvanizing, drop forging, etc. A ship requires all kinds of labor—from the very technical "tailoring in steel" to ditch digging in the shipyards. In order to build ships, twenty trades must be used. There must be an enormous educational programme, giving thousands of men their first highly specialized knowledge. There is much that is big and hopeful about this; much that is of permanent constructive value. It will mean the organization of growing towns, the building of morale which should be the finest in the world, the establishment of facilities under Government control which should result in stabilizing conditions.

With such inspiration, any laborer in the United States will be eager to give his best service. There can be found no greater loyalty nor more sincere patriotism than the American laborer feels.

INCREASED TONNAGE WILL ENHANCE INTER-RELATION OF COMMERCE THROUGH MAIL FACILITIES

A. S. BURLESON, POSTMASTER GENERAL

In regard to the transportation of the mails to foreign points, the service is restricted, except to Canada and Mexico, to the means provided by shipping, and without shipping the United States would be isolated from the rest of the world and bound to other countries only by wires under the ocean and by electrical currents used in transmitting radio messages.

In the maintenance of the foreign mail service, shipping is an absolute necessity, and, with the withdrawals of mercantile vessels for use in the Navy Department in the transportation of troops overseas, or for the now highly lucrative employment of freight carrying, the mail service has suffered and will continue to suffer unless the United States Shipping Board comes to its relief with the vessels that are under the control of that Board or being built under its supervision. There appears to be no good reason why vessels of the Shipping Board that carry freight may not also carry mails, and the closest cooperation is hoped for between the Board and the Post Office Department, in order that the extension of the mail service may grow apace with the extension of the activities of the Board.

Commercial interests in the United States suffer whenever there is a lack of mail facilities, and, with shipping

under the control of the United States authorities ample enough to take the place of the vessels of other nations withdrawn for war work, the extension of commercial intercourse with the United States will be increased and strengthened, so as to guard against reduction in the future, no matter how great the opportunities offered by foreign bottoms after hostilities cease. At this time the Department is availing itself of the opportunities afforded by naval vessels to carry mails to foreign ports to which there is a lack of carriers of other kinds, and the addition of vessels of the Shipping Board will surely give the United States the advantage in mail transportation which at no other time has the service enjoyed.

Parcel post to Belgium, Denmark, Greece, Liberia, the Netherlands, Norway and Sweden was suspended because there were no steamships available to carry the mails direct from the United States to the respective countries, as the parcel post service is restricted to vessels which land mails in the country to which they are directed, and not at some intermediate country for onward transmission. Sixty years ago it was considered good service when one vessel a week reached New York with mails from Europe, yet, quite recently, for one week not a mail vessel came into the harbor from a European port.

In regard to the transportation of the mails between domestic ports, service by steamboat has heretofore been provided under contract awarded upon advertising for proposals. On the larger lines there has been practically no competition, resulting in the payment of high rates by the Department for the transportation of the mails. Domestic service includes that between the United States proper and Porto Rico, Hawaii and Alaska, as well as the service on the water routes within the States. However, under recent legislation, this Department has ordered the carrying of the mails to Alaska and Hawaii as freight or express. If the Shipping Board constructs and operates vessels on which the mails can be carried on domestic routes, the Government will receive the advantage of having the mails carried at actual cost. Furthermore, the mail service could be considered in arranging schedules on the steamship lines, and thus improved service be afforded to all the world.

SHIPS OF OUR NEW MERCHANT MARINE HAVE DEEP SIGNIFICANCE

JOSEPHUS DANIELS, SECRETARY OF THE NAVY

The chief business of the navy so far during this war has been to keep safe the road to France. This work has been well done, due to the skill, knowledge and courage of the men who man our fighting ships. But capable as has been the overseas transport service, brave and courageous as our soldiers and marines who are winning victories in France, the vital need has been ships and ships and more ships to carry our fighting men, munitions and supplies. We need more, and every man who drives two rivets where one has been driven before is a public benefactor. More than that; he belongs to the mighty army which is preserving liberty for the men of our day and for the man of future generations.

All honor to the men who have expedited shipbuilding, who in freezing weather and in burning heat have heeded the naval signal "full speed ahead" in building ships. And all honor, too, to those who, in this supreme hour, are putting on additional steam in this patriotic service. They are as truly doing their part to win the war as are the men on the ships and in the trenches.

SHIPS WILL MAKE AMERICA SELF-SUFFICIENT

FRANKLIN K. LANE, SECRETARY OF THE INTERIOR

Ships mean to us the development of the minerals of the United States, instead of their importation from foreign countries, through ready availability, making America self-sufficient industrially.

Control of Hull Construction of a 5,000-Ton Deadweight Fabricated Steel Ship

Methods and Practices Required at Yards in Ordering Material to Facilitate Deliveries from the Steel Mills

BY FABRICATOR

IT is desirable that the material schedules covering steel requirements should be gotten out under the supervision of a man who is familiar with steel mill methods and practices. The mills themselves, as we well know, are very thoroughly organized, with a single specialty—that of producing steel—and to meet the foibles of a naval architect is all very well if the order does not interfere with the output in doing so. Usually, however, what a buyer wants is steel rather than a willingness on the part of the manufacturer to oblige.

Steel is the most important element of a steel vessel, and its source and production are given so little consideration that it is probable that the output of our steel mills would reach their one hundred percent rated capacity if the men responsible for steel purchases in shipyards and elsewhere would get out and get together and get acquainted. Incidentally, in this respect, their own organizations would brighten up.

A buyer will save time both for himself and the steel mill by meeting the requirements of the methods in

practice which are generally to be found in the various mills. In fact, the majority of the details are standardized to an extent that makes this quite easy, since there are really not so very many types of mills to confuse the shipbuilders. In general, steel mills are classified as bar mills, shape mills, plate mills, and so on, with these further sub-divided, certain mills specializing only in merchant bars, others in standard lightweight angles and channels, still others in heavy and special angles and channels, I and H beams, universal mill and sheared plate, and a few in armor plate.

Until recently there were only two or three mills rolling bulb angles, ship channels and deep beams, all of which are used almost exclusively in shipbuilding. Yet there were many mills rolling standard and structural angles, channels and beams—hence the "standard" fabricated steel ship—and the mills engaged in rolling bulbs, Z-bars, etc., were undoubtedly glad to drop them and take up standard shapes. Even to-day there is only one mill in the country rolling a certain deep I-beam very desirable as a foundation element, and an H-section which is used for pillars. Z-bars have been dropped altogether.

With the exception of the plate mills, a set of rolls will produce only one size section, and to change the rolls means putting out of service that particular mill and probably the "blooming" mill also, with a disturbance of mill processes all the way back to the soaking pits.

Mill Rolling Schedules

"Tonnage" the mill must have. That means that it must have orders that enable it to run a maximum length of time before changing rolls and disturbing processes. The mills control their output more positively by means of their "rolling schedules," which cover periods of from one week in the larger mills to semi-monthly and monthly periods in the smaller mills. They go over their orders regularly and accumulate all of the tonnage possible in a minimum number of sections and sizes which will keep their equipment running to full capacity with the fewest disturbances. The common sizes and sections in greatest demand usually receive a preference. They are easier to get, are in the schedules oftener, and the larger the order in weight and the fewer the number of items on it for that particular weight, the better the chances for early delivery, particularly if a man was slow in getting in his order.

It is well to avoid small lots of odd sizes. It would be better to make substitutes when at all practicable, or else get a heavier section or even change the design. An order for a small lot of a few hundred pounds should be purchased from warehouse stock. As a rule, warehouses have an excellent line over quite a range of shapes and sizes, and they can make shipment probably the day the order is received.

When sending an order to the mill, let it be clearly understood that the mill people must have from ten days to two weeks in order to work the order through the sales office, the order department and into the mill schedules. If the mill is a large organization, it should be permitted one or two weeks in which to roll; if it is a small one, it should be given from two to six weeks in which to roll, and, in the case of both, an additional week in which to load. A mill cannot be expected to make complete shipment of the order at one time if the order covers a wide range of sizes and sections. Even in the minimum time, two or three weeks should be allowed for grace and safety. Nor can it be expected that a mill will put any more marks on material than is absolutely necessary. The order number, with perhaps the hull number, should be sufficient guidance for the mill shipping clerk and the receiving clerk. It would be better to let the items go through with the regulation shipping marks, since the receiving clerk must check the dimensions of each item, anyway, at which time also he may put on the required marks. The marks used by shipyards ordinarily are very undesirable.

Except in a few special instances of extreme length or a few odd items of special heavy sections, buy bars, angles and channels in random lengths, or else in a range of lengths not varying more than from 20 to 30 feet. Do not bother with multiples, but buy all of one size at once. Such scrap as remains will be more serviceable and in no greater quantity than if the material had been ordered to lengths, owing to the fact that the mill cutting tolerances necessitate trimming anyway.

An order for sheared plates should be grouped by gage or thickness first and then by width; the length, of course, is immaterial. Universal mill plates should be grouped by width first and then by thickness. This grouping, however, should not be followed when ordering; it is done here to facilitate getting all gages and widths together, and to facilitate ordering. Sketch plates and circles are to be avoided in shipyard specifications. The scrap from rectangles will be used for fillers, washers, plugs, etc.

How to Order

It is well to give the mill the option of furnishing either universal mill or sheared plates and to order multiples in width and length whenever possible. When ordering multiples in width, however, see that the cutting widths are given in order that the mill may furnish narrower plates than those ordered; that is, if it should prove possible to gain time.

In ordering bars, plates and shapes, avoid lengths over 30 feet. They are very difficult to handle and to keep straight, and also require an extra car or "idler" when being transported, due to the overhang, since our freight cars average 36 to 40 feet overall. If longer items are necessary, get them all into the mill together.

Due to the jolting during transportation, items in the carload will tend to shift, which may necessitate stopping the car to re-load. Material 30 feet in length permits of a margin for this purpose. In the case of "idlers," the items have to be loaded so that the cars will take curves freely, and, because the loads cannot be made secure, the tendency to shift about is very great. A double load will rarely reach its destination without having been "shopped" at least once, due to shifted material, which will mean a delay of from one to two weeks in delivery.

Beams and channels should be ordered by expressing the depth and flange in inches, the weight per foot and the length in feet and inches.

Angles and bulbs should specify the legs—the longest one first, if unequal—in inches; the weight per foot and the length in feet and inches.

Bars, rounds, squares, etc., should specify width and thickness in inches and the length in feet and inches. In this connection it is well to remember that any item up to and including 6 inches wide is a bar; over 6 inches a plate.

Sheared plates should be ordered length, width and gage in inches, and universal mill plates ordered length in feet and inches, and width and gage in inches.

Following Standard Practice

In each of the foregoing cases, dimensions should appear on the order in the sequence given. This will meet the requirements of standard practice, and if similar sizes and plates are grouped so that a plate mill gets nothing but sheared plates on one schedule, and these in distinct groups distinguished by gages, and your angles and chan-

nels, etc., are all gotten out in a similar manner, you can be certain that your order will get very good consideration by the mill and, what is more to the point, quicker delivery.

It is well to make sure that deliveries asked for on orders meet the requirements. If the shipping schedules are properly gotten out there will be no uncertainty. Yet if one is caught short on an item it would be better to try for warehouse stores before endeavoring to break into a mill schedule. With the very best intentions, a mill may promise to put an item into a current schedule, but in most cases it will fall down sadly in making the promise good. Every person in the steel material section of a yard should be familiar in a general way with steel mill classifications and description and cutting variations. This is hardly the case, though, and Table A, covering standard dimensions and items, and Table B, covering cutting variations, should be of value in helping to bring this condition about. On occasion now and again one has use for a few sheets and light plates. Tables C and D are therefore included.

TABLE A.—STEEL MILL STANDARD PRODUCT

BARS

Description	*Minimum and Maximum Dimensions*
Rounds and squares...	3/16 inch to 7¼ inches.
Ovals	⅜ inch to 1¾ inches.
Hexagons	5/16 inch to 2½ inches.
Half ovals and half rounds	5/16 inch by 5/32 inch and less to 4 inches by 7/32 inch and over.
Flat bars and heavy bands	⅜ inch by ¼ inch to 6 inches by 4 inches.
Light bars and bands...	⅜ inch by No. 12 and ⅛ inch to 6 inches by No. 7 and 3/16 inch.

SHAPES

Equal angles.....	½ inch by ½ inch by ⅛ inch to 8 inches by 8 inches by 1⅛ inches.
Unequal angles.....	1½ inches by 1¼ inches by 3/16 inch to 8 inches by 6 inches by 1 inch.
Bulb angles.....	4 inches by 3½ inches by 11.9 pounds to 10 inches by 3½ inches by 32.0 pounds.
Bulb beams.....	6 inches by 4⅜ inches by 14.0 pounds to 10 inches by 5½ inches by 36.6 pounds.
H-beams	4 inches by 4 inches by 13.6 pounds to 8 inches by 8 inches by 34.0 pounds.
Structural beams.....	3 inches by 2⅜ inches by 5.5 pounds to 27 inches by 7.5 by 83.0 pounds.
Structural channels....	3 inches by 1.4 inches by 4 pounds to 15 inches by 3⅞ inches by 55 pounds.
Equal tees.....	1 inch by 1 inch by 0.89 pound to 4 inches by 4 inches by 13.5 pounds.
Unequal tees.....	1¼ inches by ⅝ inch by 0.88 pound to 4 inches by 5 inches by 15.3 pounds and 5 inches by 3 inches by 13.4 pounds.

PLATES

Universal mill.....	From ¼ inch to 2 inches thick by 6½ inches to 48 inches wide and from 30 to 100 feet long.
Sheared	From ¼ inch to 2¼ inches thick by 24 inches to 132 inches wide and 132 to 560 inches long.

TABLE B.—STANDARD CUTTING VARIATIONS

Beams and channels.....	⅜ inch over to ⅜ inch under
Angles and other shapes.....	¾ inch over to 0 inch under
Universal plates, length.....	¾ inch over to 0 inch under
Sheared plates, length and width.....	¼ inch over to ¼ inch under

TABLE C.—STANDARD WIDTHS AND LENGTHS OF STEEL SHEETS, BLACK OR GALVANIZED

Gage	*Widths*	*Lengths*
No. 10 to No. 30	24 inches to 36 inches	72 inches to 120 inches

TABLE D.—STANDARD LIGHT STEEL PLATES

Gage	*Widths*	*Lengths*
3/16 inch	24 inches to 74 inches	200 inches to 360 inches
No. 8	24 inches to 72 inches	200 inches to 290 inches
No. 9	24 inches to 70 inches	160 inches to 250 inches
No. 10	24 inches to 68 inches	140 inches to 230 inches
⅛ inch	24 inches to 66 inches	140 inches to 200 inches

(*To be continued.*)

Many men will see a thing for years and not understand or appreciate it, as, for instance, why it is that the sunlight coming through small openings always makes a round or oval spot of light on the floor.

Annual Meeting of Society of Naval Architects and Marine Engineers to be Held in Philadelphia

The twenty-sixth general meeting of the Society of Naval Architects and Marine Engineers will be held in Witherspoon Hall, Philadelphia, Pa., located at Walnut and Sansom streets, Thursday and Friday, November 14 and 15, and will begin at 10 A. M. each day.

The annual banquet will be in the Grand Ball Room of the Bellevue-Stratford at 7 P. M. Friday, November 15.

The Council will meet at 3 P. M. Wednesday, November 13, in the office of the secretary-treasurer, Daniel H. Cox, U. S. Shipping Board Building, 140 North Broad street, Philadelphia.

Applications for membership should be mailed so as to reach the secretary on or before November 13.

LIST OF PAPERS

"Revival of Wooden Shipbuilding as a War Emergency," by Carlos deZafro.

"Floating Dry Docks," by Charles N. Crowell.

"On Vibrations of Beams of Variable Cross Section," by N. W. Akimoff.

"Notes on Progress in Turbine Ship Propulsion," by Francis Hodgkinson.

"Structural Steel Standardized Cargo Vessels," by Henry R. Sutphen.

"Notes on Launching," by William Gatewood.

"Side Launching," by Frank E. Kirby, honorary vice-president, and Edward Hopkins.

"Experiments Upon Simplified Forms," by Professor H. C. Sadler.

"Standardization of Ships," by A. J. C. Robertson.

"Variation of Shaft Horsepower, Propeller Revolutions and Propulsive Coefficient with Longitudinal Position of the Parallel Middle Body in a Single Screw Cargo Ship," by Naval Constructor William McEntee, U. S. N.

"Recent Developments in Shipyard Plants," by Naval Constructor Sidney M. Henry, U. S. N.

"Concrete Ships," by R. J. Wig.

"The Application of Electric Welding to Ship Construction," by H. Jasper Cox.

"Hog Island—The Greatest Shipyard in the World," by W. H. Blood, Jr.

A young man began his apprenticeship in a pattern maker's shop. One day the boss gave him a hook and screw eye and told him to put the hook on a closet door. When the job was done the boss looked at it and said: "Son, you should have put the screw eye on the door and its hook on the jamb, where the hook would not knock the paint off the door when it swings." The young man answered, "You told me to put the hook on the door and I followed your instructions."

Did the young man do right, or was the boss at fault?

Air and water fluids. In compressing air very small clearances are necessary, as air is elastic. In pumping water, clearances need not be small or even taken into account, as water is non-compressible.

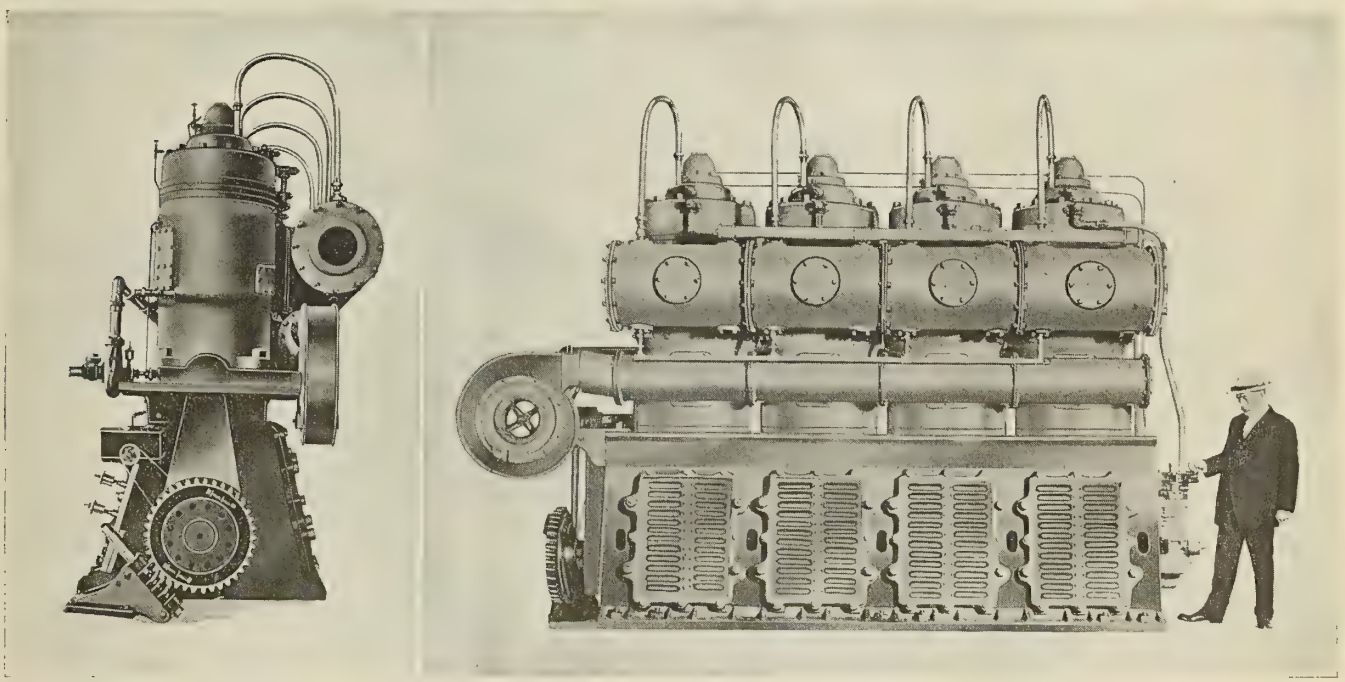
Someone has said that a path would be worn to the door of a house in which lived a man who knew more about a certain subject than anybody else in the world. That may be true, but the trouble lies in the fact that the world is slow in finding out a man's knowledge until after he is dead.

The surface blow in a boiler is, in fact, a skimmer removing all that floats; the bottom blow is a remover of sediment or anything that does not float. Both foreign materials are a detriment to a boiler. Get them out as soon as possible.

New Type of Marine Oil Engine

Two-Cycle Engine With Some Novel Features—A Simple Injection System — Subject of Scavenging Discussed

MR. CARL W. WEISS, associated with the Metz & Weiss Engine Company for a number of years and now connected with the Weiss Engine Company, 17 Battery Place, New York, has developed a surface-ignition, medium-compression, two-cycle oil engine that promises to widen the scope of the heavy oil motor. The engine illustrated herewith is a 400-brake horsepower, 4-cylinder unit, although the type is also being built with six and eight cylinders. Among other features it possesses a new method of scavenging, and, in this connection, when it is recalled that the ordinary type of surface-ignition, medium-compression oil engine uses a baffle plate in conjunction with crank case compression for scavenging—a construction which, due to uneven thicknesses of metal, makes for uneven contraction and expansion that frequently results in cracked piston heads—it is well to note that in the accompanying illustration the piston is conical in shape and a rather wide departure from usual practice.



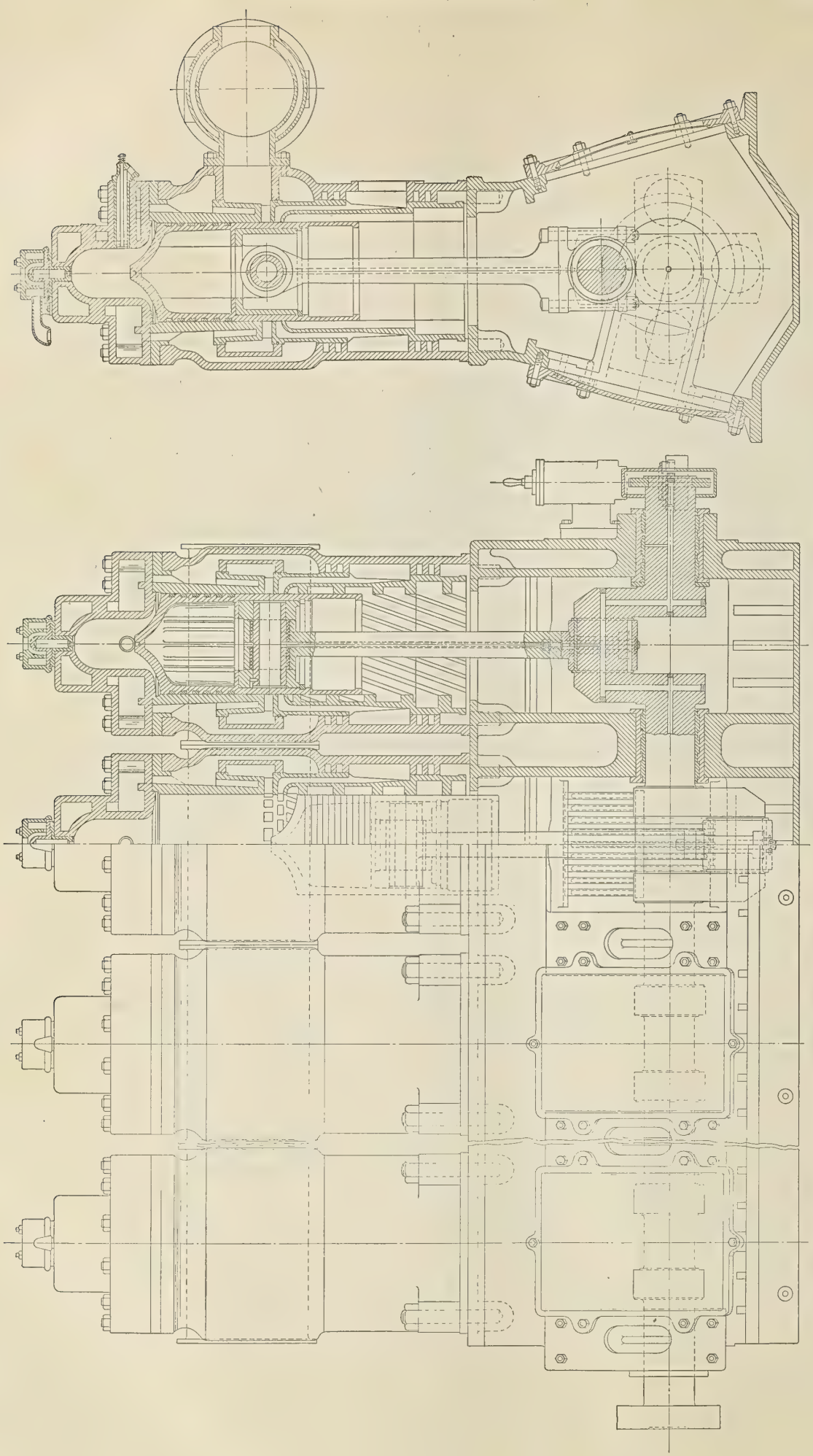
End View and Side View of Weiss Engine

Bone of Contention

The bone of contention regarding the relative efficiency of the surface-ignition, medium-compression, two-cycle oil engine has always been the matter of scavenging. That previous existing types of this style engine have not completely burned their charge or completely cleared the cylinder of burned gases after each explosion has been the contention. In the engine here shown there has been incorporated an entirely new method of scavenging. There are three annular sets of piston controlled ports: (1) the exhaust, (2) the supplementary, and (3) the crank case port. The supplementary ports are open to either atmospheric or under low pressure of air supplied (as in this instance, see illustration) by a small pressure blower. As the piston uncovers the first series—the exhaust ports—near the end of the expansion stroke, the pressure of the cylinder drops to atmosphere, and, due to the abrupt discharge and the forcible cooling of the gases, the pressure at once goes down to several points below atmosphere. At this point the supplementary ports open, allowing a charge of pure air to sweep in radially over the conical piston head, displacing the exhaust gases left in the cylinder, while immediately following this, as the crank moves through the lower dead center, the crank case air under approximately five pounds pressure per square inch also flows in over the conical piston head by way of the annular series of ports formed by the spirally ribbed lower parts of the cylinder liner. In this way three completely separate and distinct charges of air are introduced into the cylinder during the scavenging process, which, undoubtedly, accounts for the fuel efficiency of this new type and its ability to operate indefinitely without undue heating of piston head.

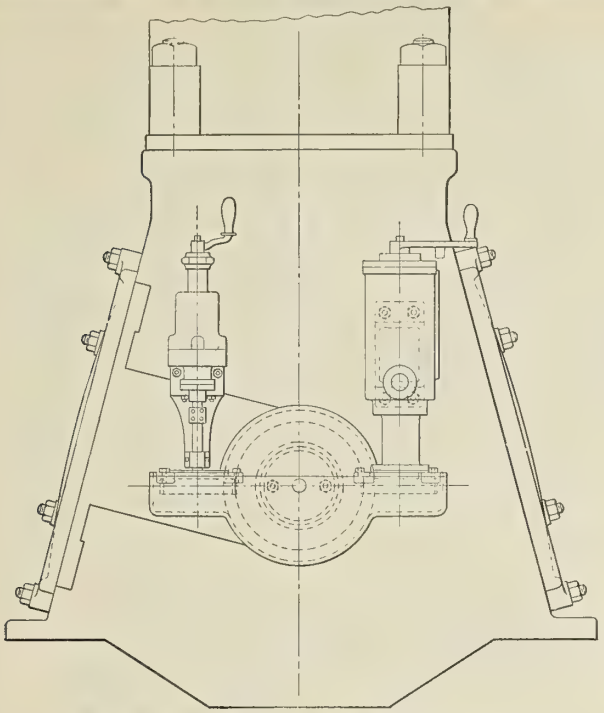
Simple Oil Injection System

The oil injection system of this multi-cylinder engine is simple. In place of direct-driven governor control injection pumps, there is an independent duplex pump to keep the oil under constant high pressure, and a compensating distributor valve, driven from the engine shaft, arranged for timing adjustment for different grades of oil and either direction of rotation. This pump is connected to the air receiver used for starting and reversing the engine. With a normal air pressure of 200 pounds in the receiver, the oil pressure is kept at 1,000 pounds by a reducing valve in the air line. Heavy oils require high pressures for efficient spraying. The governor is designed to act directly on the compensating valve and is, in fact, carried by the distributor valve and submerged.



Elevation and Cross Section of Weiss Engine, Showing Conical Piston and Cylinder Liner, Together With Method of Supporting Main Bearings from Side

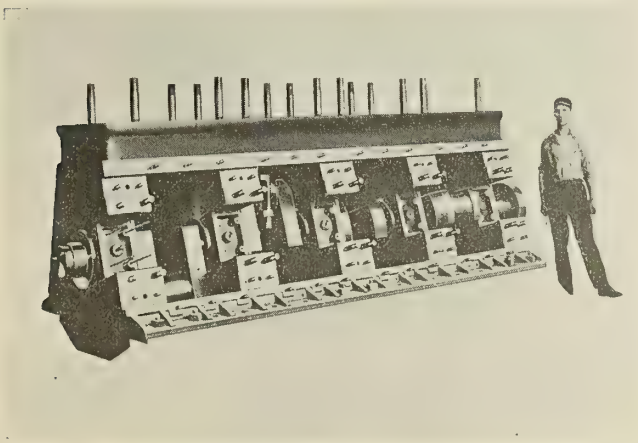
There is a spiral gear mounted on the front end of the crank shaft which drives the oil distributor on one side and the air distributor for starting and reversing on the other. Each cylinder has an air check valve piped to the air distributor and a relief valve open to the atmosphere. These relief valves can be operated either independently or simultaneously by a lever at the front end of the engine,



End Elevation, Showing Oil Distributor Valve

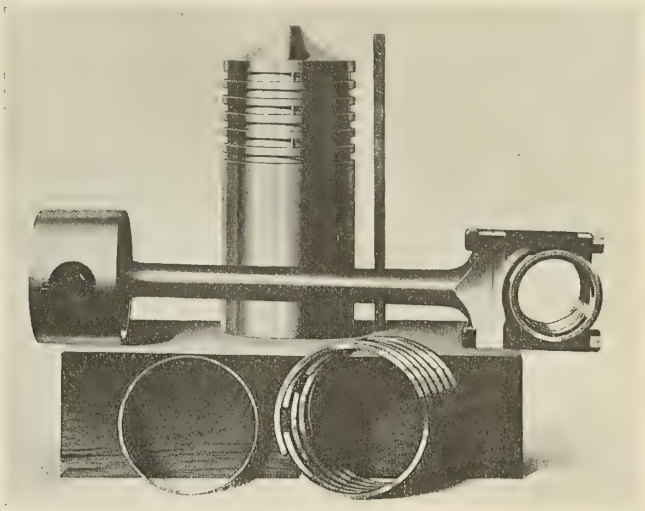
so that the entire control of speed, starting and reversing, and pressure relief is brought within easy access of the engineer.

Forced feed lubrication is used for the cylinder, main bearings, crank pin and wrist pin, each pipe terminal fitted with a lubricating sight check. These lubricators are of the single plunger, distributor disk type, furnished by L. T. Weiss, of Brooklyn, and used in large quantities by the United States Government on single- and multi-cylinder engines and guaranteed to force oil against 200 pounds



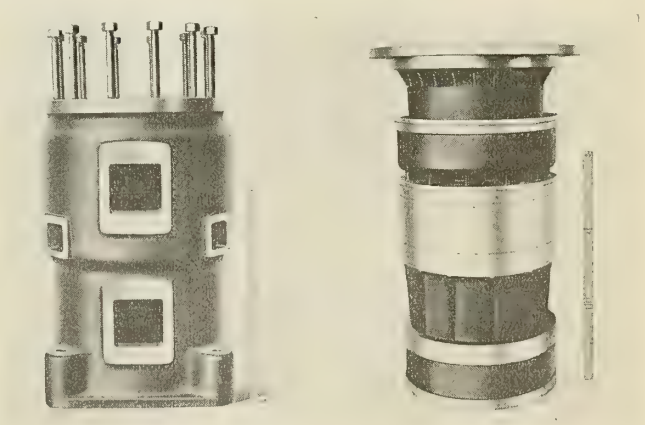
View of Crankcase and Shaft

pressure. The illustration shows an eight feed circle mechanism. A hardened steel worm engages a worm wheel disk, which latter carries a steel plunger with its operating yoke. As the check turns, the two diametrically opposite projections of the yoke and the fixed star wheel operate as an escapement, reciprocating the plunger, to draw in and discharge oil through a hole in the disk, registering alternately with the suction and discharge hole in the base. Each discharge has a screw coupling for copper tubing. The whole mechanism being very simple and substantial, and submerged in oil, with an extremely slow movement, these lubricators run for many years without the least wear or adjustment.



Piston, Piston Rings and Connecting Rod

This type of marine engine requires no fly wheel and no special scavenging pumps. The weight per horsepower is reduced to approximately 150 pounds without sacrificing a reliable factor of safety within the limits of working pressure. At a pressure of 500 pounds per square inch the maximum main bearing pressure does not exceed 509 pounds per square inch projected area. The shaft in the 16½ by 22 unit is 8¼ inches diameter. The bearing length is 12¾ inches. There is a center bearing between each cylinder in the multi-cylinder type. The bearing pressure, therefore, is 500 × 214 = 107,000, divided by 210 = 509 pounds, as stated above, while the mean pressure is below 100 pounds per square inch projected area. The mean crank pin pressure equals 290 pounds per inch projected area. The connecting rod being five crank lengths, the side thrust at crank circle tangent is below 40 pounds per



Cylinder and Cylinder Liner

square inch projected area. The piston is 16½ inches diameter and 33 inches in length, giving a projected area of 33 × 16½ = 544 square inches. The mean wrist pin pressure averages 475 pounds per inch. The size of the wrist pin is 5½ × 8¼ = 45.37 square inches projected area.

Referring back again to lubrication, which undoubtedly is one of the most important features of any engine of this type, it should be noticed that this engine uses a pressure system very similar to that adopted by high speed gasoline engines. The shaft is drilled all the way along the main bearings, crank cheeks and crank pins, with an outlet at each bearing and crank pin, so that with oil under pressure connected to the end of the crank shaft all bearings are flooded with oil and the wrist pin receives its lubrication from the crank pin through a hole in the connecting rod, provided with a check rod running the entire length of the hollow connecting rod. When the engine is in operation this rod plays about one-eighth of an inch between the wrist pin and the crank box for the purpose of checking the oil which has once passed the rod, and retaining same for wrist pin lubrication. With this pressure system there is really no need for a special check rod for the oil in the connecting rod, but this provision is of considerable advantage, inasmuch as there is no oil in the rod when the engine has been standing for a sufficient time to enable the oil to leak out. With the oil in the rod the wrist pin will get its lubrication right from the start, and this prevents any cutting of the bronze bushing which bears against the steel-hardened and ground wrist pin. In the customary way of putting the wrist pin directly through the piston, usually cast with heavy bosses on each side, the chances of conducting heat to the wrist pin are much greater than in the wrist pin carrier arrangement used in this engine.

Particular attention is drawn to the illustration showing the conical piston with its even thickness of metal, to the connecting rod, to the piston pin carrier and to the piston pin, where it will be noted that the wrist pin is mounted in a separate carrier which is locked inside of the piston by means of a snap ring, thus dispensing with the ordinary piston construction calling for heavy bosses on the body of the piston. Inasmuch as there is less heat conducted with the arrangement here shown, the lubrication of the wrist pin and durability of it is materially increased. The heat flowing from the piston wall to the wrist pin in the other style of engine necessarily makes the lubricating oil very thin, and when the engine is shut down and the lubricating oil feeds ceased, the pin becomes practically dry. Later, when the engine is started, there is a very good chance of trouble, because it takes several minutes before the oil can reach the pin. In the design of wrist pin carrier here set forth, the temperature is lowered and, with a check rod in the connecting rod, the lubricating oil is kept at a level which will provide lubrication for the pin immediately with the starting of the engine.

An Appeal to Americans

Chairman Hurley Looks Into the Future—Appeals to Manufacturers — Cause of the Ruin of Old Mercantile Marine

BY EDWARD N. HURLEY*

THE time has come for Americans everywhere to put themselves solidly behind American ships.

Our railroads must no longer stop at the ocean. We are building an American merchant fleet of twenty-five million tons—three thousand ships. We are backing modern ships with modern port facilities, establishing our bunkering stations all over the globe and will operate with American railroad efficiency. We will carry American cargoes at rates corresponding to our railroad rates—the cheapest in the world. Fast American passenger and cargo liners will run regularly to every port in Latin America, the Orient, Africa, Australia.

Are you taking steps to use these ships to increase your own prosperity? Do you realize that American products of factory, farm and mine can be delivered to customers in foreign countries on terms which will build lasting trade?

Do you realize the possibilities for bringing back raw materials to extend your products and trade?

We must all take off our coats and work to bring the subject of these American ships home to the people of every American interest and community. The manufacturer must think of customers in Latin America as being as accessible as those in the next State. The farmer must visualize ships carrying his wheat, cotton, breeding animals, dairy products and fruit to new world markets. The American boy must think of ships and foreign countries when he chooses a calling.

Has your organization appointed a live committee on merchant marine?

Is the chairman of this committee a man of international vision?

Are you applying the new world visions to the interests represented in your organization and learning what ships can do toward widening your markets?

These are your ships. It is your duty to bring them close, regard them as new railroads, spread knowledge about them through investigations, meetings, discussion.

Public neglect ruined our old mercantile marine. Congress was not to blame—it simply reflected the indifference towards ships of the average American. Once more we have a real American merchant fleet under way, backed by far-reaching policies for efficient operation. We must dispel indifference and keep our flag on the trade routes of the world. We are going to take trade from no other nation. But we must serve our own customers and help other nations in their ocean transportation problems after the war.

I want to hear personally from your organization. These are precious days of opportunity. The nation is united for teamwork and service. Let us "Wake Up, America!"—which means waking up any suggestion that you think will be helpful in our work.

* Chairman of the United States Shipping Board.

The flat top and bottom of the U. S. standard thread is produced by simply grinding off a certain amount of the point of the thread tool. The theory of the round top and bottom is that the corners of the tap will wear off, anyway, after a little use, and you had better do this when making the tap. However, the trouble with the theory is that the flat topped tap stands up well and gives no trouble in practice.

Co-operative Management—The Apprentice

The Apprentice a Vital Essential in Industry—Should Be Given Liberal Education—Freedom of the Shop Important to His Rounded Education

BY ARTHUR F. JOHNSON

AS is the case in solving all complicated problems, the method of procedure embraces a general review of the whole, followed by the consideration of each successive detailed step beginning with fundamentals.

The initial factor of the human element, as concerned with co-operative management, is the apprentice boy, the future laborer, mechanic, foreman, outside superintendent and possibly manager, depending upon his individual ability, effort and the degree to which these two traits are given encouragement and recognition. Being an apprentice boy, in all probability he is the son of a mechanic, very rarely of a clerical yard employee, since that invisible wall between white collar and blue jeans would render an office boy's station more desirable in the eyes of the clerical parent. Boys being what they are, it is usually the parents' influence which determines their initial step as wage earners, together with their frame of mind toward the work to be undertaken and the officials and working conditions in the yard where first employed.

Home Environment Important

Take first the apprentice's early boyhood and home life as affected by the firm employing his father and his father's attitude toward the firm. If the father has been fairly industrious, sober and steady, has not neglected his family and still never advanced beyond the ordinary mechanic's station except to be recognized as a "good lathe hand" or a "fine mechanic," he will serve as an example of the great mass in the laboring classes. The boy has seen the father come home contented or disgusted, has heard the conversations concerning the work, the firm and the workmen's grievances (real or imaginary), has seen the wasted lifetime with little advancement and no savings or with something accumulated to have made it worth while, and is the typical all-around boy of fifteen, with a moderate fighting, swearing and mischievous ability. Given the opportunity, his showing with an advanced education would equal that of the average college graduate, but not having the means, nor perhaps the understanding of the value of education, he contents himself with going into the shipyard, there to pursue a trade. Possibly it is the identical one followed by his parent, but in any case the apprentice's knowledge of its possibilities is slight. He imagines that once equipped with a "trade," he is a finished man. Having at best completed a grammar school course, it is decided by family consultation that he'd better start "earning enough to buy his clothes." He goes to the yard, applies at the employment office, if such there is, and starts in by carrying water, scraping boilers or holding tools for a mechanic.

This is the point at which his opinion begins to be molded, and that at which the firm should take most active interest in his case. It is too often that apprentices are tolerated as necessary evils. Interest and application to a task vary in direct ratio to the extent in which effort is observed and appreciated. If the apprentice finds himself very unimportant, is given no systematic instruction, must content himself with brusque and often incorrect replies to his queries, there is every reason to anticipate poor progress on his part.

A well-organized apprentice system should be under the direction of a "supervisor of apprentices" chosen for his knowledge of the works, organization and ability to understand youths, discriminating in their employment. He should work harmoniously with the department heads and foremen of the branches in each department.

The duties of this supervisor would be original selection of apprentice candidates, their placing in the trade best adapted to their leanings, observation of conduct and recording the progress of apprentices, transfers into other branches if found desirable, promotions, settlements of grievances, discharges and supervision and administration of instruction.

Education and Credentials

The apprentice system proper would originate in the employment stage, candidates being received at stated periods only (say monthly), and being required to present statements as to education, credentials as to moral fitness and a personality subject to scrutiny of the supervisor. Applications would be submitted on a company form and filed, employment varying with demands of the plant. In this connection, co-operation with school authorities (grammar and trade) would afford most desirable material. Candidates would state their preference as to trade, but this would be subject to revision after the "visiting course" which would cover the first week of apprentice training. In this course a tour of the works would be made, one day being spent in each department in tracing the work from source to completion, explaining the relation and interdependability of departments and pointing out the duties and requirements for each trade involved. The apprentice would then be questioned and his preferences and fitness for particular trades noted. For example, he might prefer hull work, engine work, woodworking, pattern making, smith work, etc. If advisable, he would be started in the department desired, subject to transfer or discharge if proven inadept.

Detailed to a given department, the apprentice would serve for some two months in each branch of that department and under a different mechanic each week. His deportment, skill, originality and powers of observation would be noted and marked. At the end of a year, or subsequent to this inter-branch course, he would specialize for the remainder of his apprenticeship in the branch most suitable, as testified by his showing. Little selection being afforded by these, appointment would be governed by requirements of the plant with candidate's assent. At this point in the course the point should be made of allowing the apprentice full power of employing initiative, tempered, of course, at the discretion of the foreman in charge. No stated time would be required in apprenticeship. A minimum of one year's branch specialization with sufficient additional service to insure fitness as a mechanic would offer an opening for display of ability and prove an incentive to close study of the trade.

Times for Study

The practical instruction thus far outlined should be enhanced by an "instruction" course under direction of

qualified instructors from the drafting and planning sections, as well as the foremen from various shops. Apprentices would meet periodically on stated mornings for study of materials, machines, shop work and plant methods, blueprint reading, mathematics and mechanical drawing. Exceptionally bright individuals would be encouraged to prepare in spare hours for higher education and then enrolled in recognized technical schools through some method of loans or endowment.

Care should be exercised not to present too philanthropic advantages nor to require the students thus aided to obligate themselves too deeply. A service of three years subsequent to college graduation, with summer vacations additional, should absolve the youth from any feeling of indelicacy in seizing exceptional opportunities for advancement. Possibly one in fifty would show inclination for advanced education. The remaining apprentices would be rated mechanics through consultation between shop executives and the supervisor of apprentices.

Every encouragement to promote fellowship and athletics among these youths should be put forth. Athletic contests and even team contests with other works or between departments in a given plant would be excellent stimulus of morale.

The inauguration of a complete system as here outlined would require considerable thought and some expense. The idea is not novel, nor has it been untried, for the apprentice systems in Great Britain are arranged along the same general lines. Some of the features, notably those of social or athletic character, are in force in American plants, but the standardization of apprentice training has not yet received general consideration.

From the industry's standpoint, its adoption with modifications to suit particular establishments on the part of firms independently, would produce varied thoroughness in the training, resulting in somewhat better conditions than at present, but diversity in qualifications of the mechanics produced. If such training were adopted, the obvious necessity would be consultation between the various shipbuilding firms through a representative committee handling this and other labor matters. This committee should embrace skilled and trusted representatives of the trades in addition to firm executives, that the resulting apprentice system might prove most practicable and beneficial.

Apprentice training at present is so variable in thoroughness and degree of skill developed, it produces such a conglomeration of "mechanics" and has its standards fixed so wrongly by period of employment, rather than by learning assimilated during the period, that remedial measures should be instituted.

It is obviously improper for labor unions to set standards determining mechanical ability, not because they are incapable of doing this, but that the results attained are not always what they should be. Mechanical training in its different branches must be as nationally standardized as are the professions, that the industries may compete with certain and intense oppositions when industrial conditions resume their normal trend.

It is questionable whether opposition to such standardized training could be based on the grounds of expense and satisfaction given by the present system. Very probably the losses entailed through improperly and systematically trained labor are far in excess of the expenditures necessary for correction of this evil.

The Port of Seattle

A Terminal Harbor of Unusual Excellence—A Big Engineering Feat—Due to Growth of Overseas Commerce

BY CHARLES PHILIP NORTON

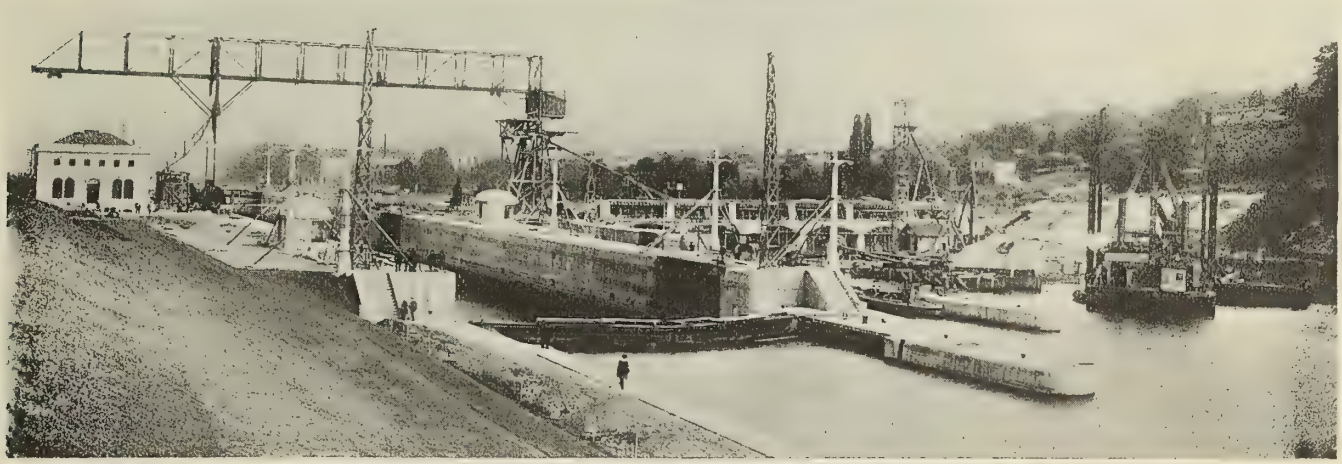
At the present time the harbor of Seattle includes fully 140 miles of deepwater shore front, but a small fraction of which has been occupied by harbor facilities and industrial establishments. Elliott Bay itself is practically landlocked and is consequently never subject to the destructive storms and heavy seas. Owing to this immunity, until within the last few years, the piers and terminals of Seattle were of quite simple and rough structural character.

To-day Seattle possesses several of as fine terminal establishments as modern harbor engineering has been able to conceive, and the total investment represented in their construction is considerably in excess of ten million dollars (£2,050,000). This includes the six magnificent piers and terminals built and operated by the Port of Seattle, built at a cost of more than $6,000,000 (£1,230,000), procured from the sale of bonds voted by the port district, which embraces Seattle and King county, under the management of three commissioners, elected by the people. The executive officer, appointed by the commission, is known as port manager, Hamilton Higday being the present incumbent of that office.

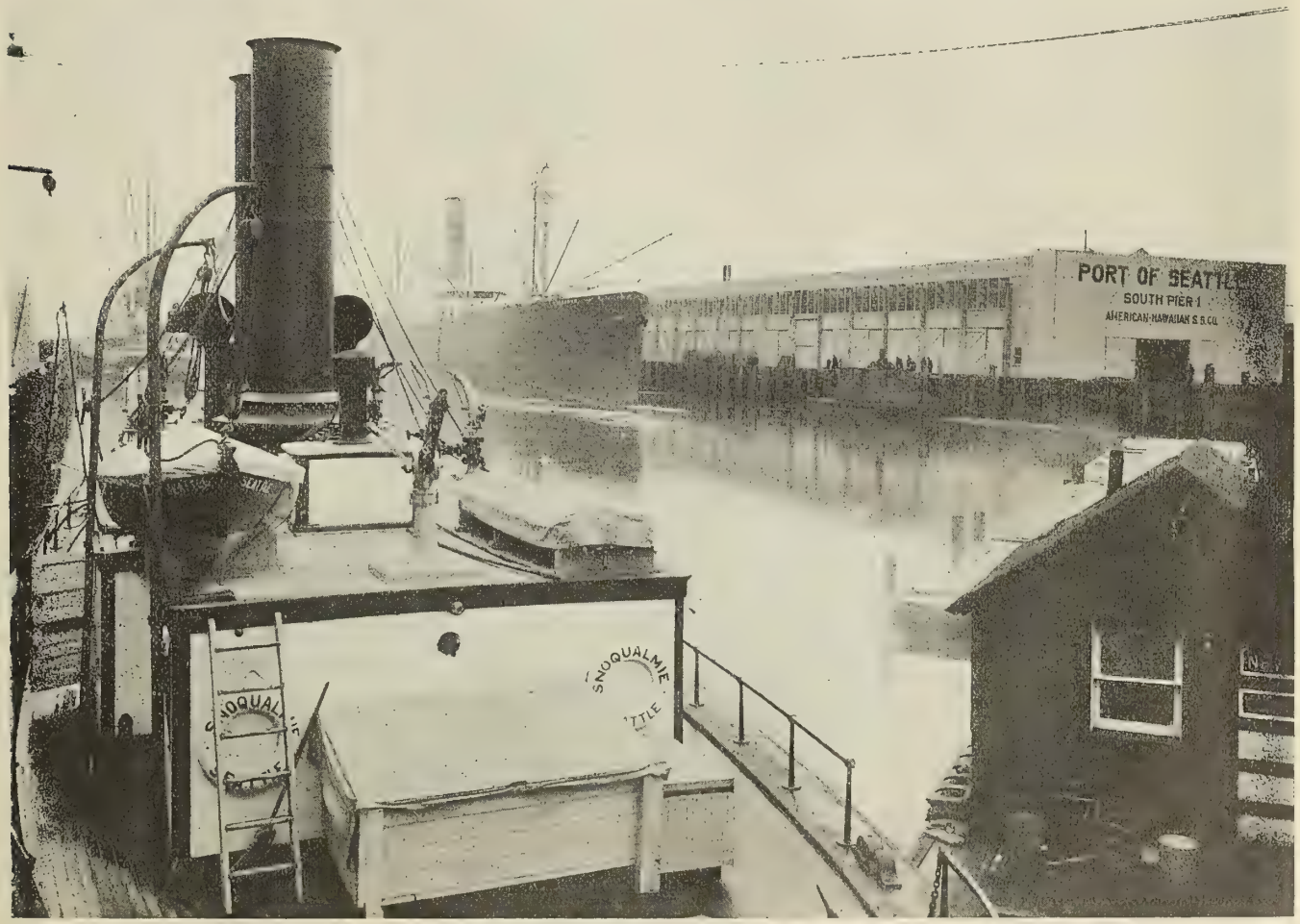
The astounding growth of Seattle's overseas commerce in the last decade, and particularly since the beginning of the world war, the volume of foreign trade having grown from a valuation of $59,031,495 (£12,100,000) in 1910 to $376,076,357 (£77,000,000) in 1917, and the number of trans-Pacific steamship lines out of Seattle having in the same time increased from three to sixteen, confirmed the wisdom of Port District development, which was completed just in time to supply, in large measure, the chief needs of this immense commerce, although even this large addition to harbor establishment has not been sufficient to adequately accommodate all the shipping offered for transshipment by rail or for export.

One of the unexpected developments of this trans-Pacific commerce has been the vast quantities of Oriental oils shipped through the port of Seattle, and for which there was not a proper terminal preparation, the oil-storage capacity, up to this time, being 12,500,000 gallons, with a delivering capacity of 1,000,000 gallons per hour. To meet this situation, Rogers Brown & Company has constructed one of the largest and most thoroughly equipped oil terminals in the United States, upon a site in the West Waterway, Seattle harbor. This terminal is designed specially for the accommodation of Oriental oils, and the tank storage capacity alone aggregates 1,000,000 gallons. The terminal is available directly

Seattle's Waterfront



Locks and Spillway from Salmon Bay, on Lake Washington Canal, Seattle



One of the Seattle Port Commission's Municipal Docks

to all ocean vessels and represents an investment of approximately $300,000 (£55,000).

By a careful survey of Seattle terminal facilities completed last year by the Transportation Bureau of the Seattle Chamber of Commerce and Commercial Club, which survey does not include data of later developments, such as the Union Pacific terminal, the following ascertained facts then existing are afforded for the consideration of those studying the extent of Seattle harbor improvements and their character:

Average depth of water at pier head line, extreme low tide, 25 to 42 feet.

Wharf Dimensions.—Total covered shed area, 2,500,000 square feet, 9,000,000 cubic feet; average floor load capacity, 600 pounds per square foot. Total outside area, 1,000,000 square feet; average floor load capacity, 500 pounds per square foot.

Pier Berth Room.—Number of 400-foot vessels which can be simultaneously accommodated loading or discharging, 100. Number of tons which can be loaded on such vessels per 24 hours under normal conditions: General merchandise, 60,000 tons; steel and heavy machinery, 50,000 tons; lumber, 6,500,000 feet board measure; grain, bulk, 10,000, sacked, 48,000 tons.

Storage Capacity—Merchandise.—Wharf shed, 250,000 tons; warehouse, 250,000 tons; open space, 200,000 tons. Waterside cold storage capacity, 35,000 tons. Waterside grain storage capacity, 100,000 tons; delivering capacity in tons per 24 hours, bulk grain, 8,000, sacked grain, 5,000. Storage capacity for steel and heavy machinery, wharf, 3,000, open space, 1,873.

Alaska Fishing Boats in Fresh Water Harbor, Lake Union, Seattle

Waterside Fuel Facilities.—Storage capacity in cars, 12,000; delivering capacity in tons per hour, 10,000. Oil storage capacity, 12,500,000 gallons, delivering capacity per hour, 1,000,000 gallons.

Mechanical Handling Equipment.—Modern, single lift capacity, locomotive cranes, 10 tons; gantry cranes, 5 tons; stiff-leg derricks, 15 tons; shear-leg derricks, 100 tons.

Dry Docks.—Six dry docks, combined lifting capacity, 50,000 tons.

Railroad Service.—Spur track capacity in cars, shipside, 500, landside, 1,100 cars.

Some Insufficiently Considered Details of Ship Construction and Equipment*

Analysis of Conditions of Yard Management—Details of Ship Equipment Criticized—Stresses on Cargo Gear

BY C. WALDIE CAIRNS, M.SC.

IT will be generally admitted that shipbuilding art and science have reached a fairly satisfactory position, though there must be possibilities not yet fully realized in the more efficient application both of labor and present materials towards the production of efficient vessels, and we hear more than rumors of new materials. No doubt, too, much useful information has yet to be obtained and disseminated as to the form best suited to any desired speed and deadweight, but in the main we may assert that the modern steamer generally "keeps right side up" and gets through the worst weather with fewer serious instances of strain either to upper works or to bottom than in the days when the registration societies were struggling with the problems arising from increase of size and of fulness of the ordinary cargo ship.

The writer has no intention in this contribution of invading the domains of the naval architect in any of the important provinces mentioned, but wishes to direct attention to a number of items which, from his experiences with shipbuilders and ships, he judges receive somewhat scant attention in the ordinary cargo steamer equipment.

It is not suggested that all shipbuilders neglect all the items mentioned. Attention to these details varies greatly. The practice regarding some of these is excellent in certain yards, but the writer has seen important items overlooked in yards that, in most respects, are at least up to date. None of the items referred to account for much in the total cost of a ship, but they may mean a great deal in relation to subsequent satisfaction, safe working, or freedom from irritating small repairs.

Certain of them might well be the subjects of standardizing agreements or of a standard fittings specification

* Read before the Northeast Coast Institution of Engineers and Shipbuilders, Newcastle-upon-Tyne.

which would eliminate a slight advantage in the market that a "mean" yard may hold over a yard where quality is considered.

Practice with regard to some fittings is not even sufficiently standardized in individual yards, choice of details being occasionally left to foremen, apparently without any standard arrangement to be complied with.

The necessary minimum scantlings and ground and mooring tackle are already imposed on builders in the rules of classification societies. It would be a convenience to owners of ships, and no doubt to builders also, if a well considered minimum standard in other details of equipment could be formulated, or even a series of grades of equipment which could be referred to by distinguishing titles. There might, for instance, be a minimum *Coasting Collier Equipment* or *Class* 1 and *Class 2 Coasting Collier Equipment*—similarly, one or more grades of *Baltic Trade Equipment,* of *Collier and Ore Trade Equipment,* of *River Plate Trade Equipment,* of *Eastern Trade Equipment.* Some of these would differ comparatively little in main features.

Possibly the commencement made by this institution on the North-East Coast Institution engine specification, which is already leading to national developments, may, by its example, induce this or another institution to make an effort to standardize good practice in some of the details that will be referred to.

It may be urged, why not specify what you think good in the ships in which you are concerned and let others put up with what they get? Laying aside many strong reasons and giving the selfish one, good details are much more cheaply obtained when they are general practice than when they have to be specially bargained for and perhaps specially designed for one's own ships.

Chain Cables

One point regarding these concerns the shipbuilder. Possibly the shipbuilder will insist that the point rather concerns the owner and his advisers, but as it is a point that becomes apparent on design of hawse pipe, the shipbuilder has first cognizance of it. This point is this—with most stockless anchors, in any but the smallest ships, the jointing shackle between anchor shackle and end link of cable is, with the anchors in "stowed" position, so far down in the pipe that it is impossible to knock out the shackle pin without lowering the anchor out of hawse pipe. If this unshackling were only required in dry dock, little harm would result, but as it is necessary, under certain conditions, to moor ships by the main cables, easy access to an end shackle is of importance. This is easily arranged for by the provision of a short length of cable, say four to eight feet long, according to need, on each anchor, thus bringing the shackle into an accessible position above deck, where, after the anchor has been "hung off," the shackle pin can easily be driven out.

The next point regarding cables is to some extent a reflection on the makers. Cable makers are supposed to work to some standard as to dimensions of cable links, end links and joining shackles; presumably, again, this is the Admiralty Cable Scale, of which the windlass makers issue useful tabular particulars. The form of certificate issued from the proving houses records the "length and breadth of link," but no report is made of variation among lengths of links, nor is any permissible "degree of tolerance" stated on the certificate.

Correct form of links, with consequent correct pitch of links, is of the greatest importance for reliable operation of the windlass. Cable lifters can, of course, be designed for any pitch of chain, but if the pitches are not reasonably equal throughout a ship's equipment, "jumping" of the cable over the "lifters" may ensue and undue wear and tear of the "whelps" will certainly occur.

Reference to this matter is not to be considered "finicky" or pedantic. A case came under the notice of the writer during the last three years where a large part of the cable equipment of a new steamer had to be replaced for this reason, and within the last few months he took an opportunity of checking over five lengths, all just delivered from one maker, and found the following variation in length overall of ten links when ranged by hand in dry dock bottom: No. 1 length 6 feet 9¼ inches, No. 2 length 6 feet 6¾ inches, No. 3 length 6 feet 8 inches, No. 4 length 6 feet 6 inches, No. 5 length 6 feet 9 inches.

Windlass makers probably do not expect perfection of pitching, and cable makers certainly cannot attain it, but some limits might well be agreed and test house officials might then be directed to check all lengths of cable when under light tension and record on certificate the correctness of end links and the maximum and minimum lengths over ten links, with power to reject cables not coming within agreed limits of variation.

Mooring and Warping Arrangements

The needs and requirements of our sailor friends deserve the fullest attention in this matter, and if their ideas appear to have expanded recently in connection with the fittings deemed requisite on even common tramps, we should remember that dimensions of such ships have continued to grow in most trades, and that at the same time lengths of jetties and berths have not necessarily been growing proportionately. Hence, methods of mooring and of handling warps that were possible under bygone conditions may no longer be applicable; for instance, hauling lines often now have to be run out from positions in the middle half-length of a steamer instead of over bow or stern as on shorter ships or at berths of great length. Further, at coal tips or other crowded berths ships are often scarfed or laid with their lengths partly overlapping, making safe and handy means of working breast ropes necessary.

It will be judged from this that all requirements are not fulfilled by quick-warping drums on windlass and a warping winch on the poop, useful and necessary as these helps are.

Fairlead sheaves on comparatively light cast iron stools are often fitted in neighborhood of windlass and of after winches. These are usually strong enough to act as guides or supports for warping wires between warping chocks and winch or windlass, provided the angle between the two directions of the wire is nearly 180 degrees, and these fairleads are useful in their own way, but what is really required in addition is the placing of strong warping guides on deck or on stools between winches and in other positions to deal with breast ropes. In some positions these ropes may have to be led with parts nearly or quite parallel, so applying to the fairlead a load equal to double the tension of the rope.

Fairleads and Bollards

These warping guides would not only save time in working the ship but would minimize the number of occasions when snatch blocks—easily strained and always destructive to the ship's wire—have to be used.

Fairleads are fitted at ship's side as well as the extra fairleads between winches. In too many cases horn fair-

leads only are fitted at side; these fairleads should be of ample strength, equal to the old horn fairleads.

It is also important that bitts or bollards should be so placed that the hauling line passes close to them between fairlead at ship's side and fairlead at winches, as this enables stoppers to be so used as to avoid loss of tautness of line while transferring from winch drum to bitts.

For all fairleads for warps there is a healthy tendency toward the use of sheaves of large diameter, and in most cases these sheaves are now provided with brass bushes.

The warping fairlead of old form is still common. In this type bushing of the roller or sheave is not sufficient; a brass washer should be provided at top and bottom also, otherwise the roller will almost invariably be found to be rusted up solid before the ship is many months old.

There are, however, several special forms of fairleads on the market and already widely used; their cost differs but little from the common form. As they are all self-lubricating and fitted with sheaves of large diameter and of good form, they are a distinct advantage to a ship in saving wear and tear of hauling lines. A point to be borne in mind, however, is that they give somewhat poor guidance to a wire led upwards steeply from ship to quay; some special arrangement may be necessary if much work of that kind is expected. These conditions rule in Panama Canal locks and have made necessary a form of mooring chock which will prove useful both under such conditions as to quays and where, as sometimes happens, a line has to be led from a loaded ship up to a light ship lying alongside.

Cargo Gear

One always feels that in a well organized world ships would not require to be fitted with a heavy and expensive outfit of cargo gear, to spend probably four-fifths of its time as ballast or as so much idle weight to be carried round at sea. However, while there remain ports where vessels may be asked to lie—as frequently at Hull, Rotterdam and elsewhere—with lighters at each side to receive cargo worked out by the ship's own winches, or ports in which, although quay berths are provided, enterprise does not "run to" cranes—ships other than those serving special trades must continue to carry about with them anything from four to thirty winches, with, in the latter case, a forest of masts, derricks and derrick posts to enable them to be utilized.

The elementary theory as to loads on derricks, spans, runners and blocks has been written about, calculated about and reduced to handy form in numerous textbooks—some even specially written for easy comprehension by the least mathematical of ship's officers. In spite of this, it is rare to find a sound view of cargo gear taken, even in the drawing office. In many yards cargo gear appears to have just grown by some system of trial and error, presided over by the foreman blacksmith. This man is, in most cases, a good man at his trade, but it does not follow that he is consequently an authority on determining dimensions or stresses.

The writer remembers the case of one yard where, repenting of these ways, the drawing office set to design derrick fittings, and a quite neat design was evolved. Unfortunately, the designer forgot that derricks are ever swung out over the side, and the span-head connections, while fairly satisfactory for the direct tension produced by a fore-and-aft position of derrick, were stressed to over 16 tons per square inch by the bending strain produced by the thwartship direction of spans when derricks were swung out. Probably the foreman blacksmith's eye, without calculation, would have been safer than this incomplete consideration.

Another example of the insufficient consideration given to cargo gear is evident in the choice usually made of cargo blocks for derrick ends.

Supposing a five-ton lift is required, the experts who order and the makers who supply the blocks usually consider they have behaved liberally by arranging for a block tested to seven and one-half or perhaps ten tons, and the unsuspecting sailorman and stevedore are expected to go happily and trustfully about their business of lifting a five-ton load. But what is the real margin here? First of all, considering deadload effects, the block under a seven and one-half-ton test is loaded. When supporting a five-ton load, in working positions, the method of application is quite different and results in pressures on pin and tension on suspending eye amounting to from about 1.8 times the load with derrick at 45 degrees to 1.95 times the load with derrick at 75 degrees. So the margin of test load over working load, instead of being 50 percent or 100 percent, has vanished, even if working load is a dead load.

The test load on the block, having been carefully applied by a testing machine, is certainly a dead load, producing stresses directly calculable by elementary methods. Working loads on cargo gear are, however, live loads—very much so. No matter how carefully they may be picked up, surgings and shocks are invariably produced in lowering and checking; by these the stresses are at least doubled as compared with those produced by the dead load arising from supporting the same weight at rest. This further discounts the utility of the test load, which in reality stresses the block much lower than working conditions will.

There is no doubt that we are often saved from breakages of cargo gear by the fact that the system yields when a load is checked or surges, or drops after a check. This yielding is mainly from the elastic stretching of the material of the span, runner and shrouds along with the deflection of mast or derrick post from unstrained position. The importance of this yielding, as a means of modifying the severe effects of impact, may be judged by the following comparison:

Assume a load of one ton drops from rest, with a free fall of one inch before the cargo gear begins to check its descent. At the moment when fall has been completely arrested the reaction of cargo gear is as follows, varying with the amount of give of the gear:

Yield of Point of Attachment of Load from First Check to Final Stoppage of Fall Inches	Reaction Stressing the Cargo Gear (1-Ton Load) Tons
1	4.00
2	3.00
3	2.66
4	2.50
6	2.33
12	2.16

It will thus be seen how difficult it is to get the stresses down even to double the stress arising from a dead load of the same weight.

Calculation of the expected yielding of the point of attachment would be somewhat tedious, especially as the bending of mast and stretch of shrouds are involved, but as a guide to the order of the dimensions involved it may be pointed out that the extension of 120 feet of steel wire rope, when stressed up to 6 tons per square inch, is probably between 5/8 inch and 1 inch. This 120 feet is mentioned as being the approximate total length of runner plus span, taking span as being carried down to cleats or bitts near deck. If a manila downhaul tackle is fitted the yield will be much greater and the multiplication of nominal stress somewhat decreased.

The old Admiralty "tests and loads for chain" quoted by Mackrow gives figures on the following basis:

1-inch chain—breaking strain, 27 tons;
proof strain, 12 tons,

and states that the working strain for crane chains, etc., should not exceed two-ninths the breaking strain or half the proof strain.

It is to be noted that the stress on material, taken on sides of chain links, would thus be:

At breaking load.	17.2 tons per square inch
At proof load....	7.63 tons per square inch = 17,100 lbs. per square inch
At working load..	3.81 tons per square inch = 8,550 lbs. per square inch

The working load stress may appear high, but it must be remembered that a chain load is never reversed.

Presumably this refers to the best class of wrought iron, of which the breaking stress of the unworked material would be sensibly higher than the breaking stress of the chain on test. Even making allowances for such steel as is now used in blocks and other cargo gear forgings or stampings, in place of iron as in chain, it would not appear advisable to exceed these calculated stresses (that is, calculated as if dead loads), particularly in view of the somewhat indeterminate live load effects already referred to. This much we can definitely say, that where we design for a nominal stress under dead load of about 3.8 tons per square inch, the live load effect will raise the actual stress at least up to the proof stress of 7.6 tons per square inch, and, while the margin between the latter stress and the breaking stress of mild steel in either forgings or stampings is none too great, still less is the margin between the proof stress and the elastic limit excessive.

It should never be forgotten that the factor of safety, where live loads are concerned, is not more than half its nominal dead load value.

Textbook and Common Sense

Now all this cargo gear criticism is merely a mixture of elementary textbook and common sense—or what the writer hopes is common sense—but unfortunately he finds that the textbook and the common sense points of view are not always applied to cargo blocks. The shipbuilder usually orders from manufacturers an outfit of ready-made blocks, tested to five tons or seven and one-half tons, or whatever occurs to him as a reasonable margin over the owner's desired lifts. Manufacturers are not infallible, either. In the case of one much patronized maker of blocks a request for drawings for inspection brought the reply, "Sorry, we have no drawings. Our work is all done to templates." In such a case there is always a fear that there never have been any drawings, or that ancient error has been copied from another manufacturer. Some alleged specialties are admittedly "designed" by copying those of other makers, mistakes included, without any questioning criticism on the part of the copyist.

The writer has examined stresses of a cargo block, dimensioned and found stresses per ton of load at eye (or what is the same, per ton load on pin) as follows:

Part	Nature of Stress	Per Square Inch Stress per Ton Load at Eye
Pin	Shearing	.338 ton or 724 pounds
Pin	Bending $\frac{WL}{8}$ taken	.918 ton or 2,060 pounds
Pin	Pressure on bearing	869 pounds
Binding	Tension at pinhole	.491 ton or 1,100 pounds
Oval eye	Tension on sides	.4075 tons or 915 pounds
Neck of eye.....	Tension	No data

The maker's test load for this block is not known; the working load suggested is five tons, and, after making allowances for method of application of working load, the apparent stresses (leaving live load and shock out of account) are as follows:

Stress No.	Stress or Load per Square Inch Under Proposed Working Load
1.....	3.29 tons or 7,050 pounds
2.....	8.94 tons or 20,000 pounds
3.....	8,450 pounds
4.....	4.78 tons or 10,700 pounds
5.....	3.97 tons or 8,910 pounds
6.....	No data

A double sheave block proposed by makers for a test load of twenty tons showed, when investigated, stresses under test load as below. Stresses under working load are also tabulated assuming working load half the test load and that, as is possible, the block is used combined either with a single or a double sheaved block, the fall rope adding in the one case one-third, and the other one-fourth to the load on pin and on eye.

		Stresses—Tons per Square Inch Under Working Loads.		
Part	Nature of Stress	Under Test (20 Tons)	With Single Block	With Double Block
Pin	Shearing	4.81	2.77	2.6
Pin	Bending	2.57	1.70	1.6
Pin	Pressure on bearing	2.86	1.90	1.79
Binding	Tension at pinhole	8.90	5.94	5.55
Oval eye.....	Tension in sides	10.00	6.70	6.25
Neck of eye...	Tension	13.4	9.00	8.43

It will be noticed that in a double block, whether coupled with another double block or with a single block, the effect of the fall rope in reducing the margin between real effect of working load and the test load is much less than in the case of a single sheave block already commented on.

The writer submits that even allowing for the fact that the loading of the blocks, like that of chains, is never reversed, some of the stresses tabulated are very much too high, both on test and on working loads, and especially with the working loads when in addition live load effects are kept in view.

One might examine the whole range of details of cargo gear and find much to criticise; probably in many cases stresses even above those tabulated could be discovered.

It may be asked, "How are there so few accidents with cargo gear?" One help is that even where, say, five-ton gear is specified, a ship may make many successive voyages with only two and one-half or three-ton lifts to make, and when a five-ton lift is made a distrustful chief officer will often take special precautions, such as using purchase blocks and preventers. It will be admitted that if gear is installed as five-ton gear, these precautions should not be necessary; a little care would ensure this at comparatively small expense if good practice were, by a standard specification or otherwise, made common. Most of us know of accidents under present conditions of design.

Meanwhile, may the writer suggest that a reasonable basis for stresses in cargo gear forgings of steel would specify that where loads in a single direction only are to be applied, stresses should not exceed a nominal 8,000 pounds per square inch under working loads, that where reversal of stress occurs 5,000 pounds per square inch should not be exceeded, and that both these figures should be reduced where sectional area of any parts is less than one square inch or a part is less than five-eighths inch thick.

These stresses would allow some margin for live load effects, but parts subject to wear should be dimensioned in excess.

From this short consideration of stresses on cargo gear the writer would like to pass to consider for a few minutes some points in cargo gear arrangements.

Many ship general arrangements, when examined, show a fore stay and a back stay to each lower mast, and it will generally be found that these stays have been taken into

consideration in the staying of the mast against cargo loads

In view of the fact that derricks, even where fitted in pairs, must swing across the center, those stays have to be "let go" during working of cargo, unless work is never to be carried on simultaneously at two adjacent hatchways. These stays are useful to prevent undue vibration of the mast at sea, but they should never be counted on for cargo discharging purchases; the necessary support to the mast should be obtained by spreading out the lower ends of shrouds sufficiently and, where ten to twenty-ton lifts have to be provided for, by fitting additional shrouds for temporary use on the opposite side of the mast to the heavy lifting gear with their lower ends still further spread out. These will not seriously hamper discharging from adjacent hatchways, especially as during extra heavy lift work in adjacent hatches will generally be suspended.

A point about heavy lifting gear sometimes neglected is that the step for the heavy derrick should be placed as close to the mast as possible, so that it may be, as directly as possible, under the point of suspension of the span at lower mast head, otherwise the guying of the heavy derrick requires heavy tackle.

Details of all this gear require careful consideration. Some of the commonly used arrangements of long links and shackles for span heads are not satisfactory, stresses being excessive in certain positions of the derrick.

Another important point with regard to cargo gear is the means for handling derrick spans. In some cases a purchase block is fitted above derrick with a guide block on cross tree of mast, forming a purchase tackle, the fall end of the same wire being led to belaying cleats or bitts about the base of mast.

To raise or lower the derrick with this arrangement is rather a dangerous operation, as the wire has to be stoppered and the end taken to winch barrel or warping drum, and when the derrick has been lifted to somewhere above the desired position it has to be again stoppered, while the wire end is again made fast to cleats or bitts.

To avoid the danger and inconvenience of these operations, a topping lift should be fitted to each derrick, the simplest arrangement consisting of a single part span passing over guide block at cross trees of mast with a downhauling tackle either of light wire or of manila connected to an eye in the span end, which is at cross trees when the derrick is down. With this arrangement the derrick can be lifted or lowered to any desired position and the working span fall then made fast to bitts or bollards.

The writer feels that in touching on cargo gear he has taken a bigger subject than can be reasonably dealt with as part of a general paper. There is undoubtedly room for an examination of the whole subject, and plenty of material for a long and important contribution to the proceedings of the institution.

Erections

It will be remembered by many of the members that there was a time when so-called erections on a ship were practically neglected in strength calculations. It seemed to be taken for granted that because they were lightly constructed they did not take part in the straining of the ship.

While shipbuilders and others neglected this, natural laws did not, with the result that these erections were subjected to stresses roughly proportional to their distance from the neutral axis of the vessel, although possibly they did not add very much to the strengh, in view of their lightness.

The results showed themselves in various ways—upper decks tearing, houses working, and in some cases weakness showing on a strong deck at the abrupt end of a house which stiffened it locally.

In the main parts of the structure of a ship these bad effects are now prevented by suitable means, but there are some minor ways in which the operation of the laws of elasticity show themselves. The writer has in mind a case which he saw recently, where a bulwark plate was fitted abreast deck houses on a shelter deck ship. The ends of the bulwark plates were shaped for sightliness and there was no great indication of strain there. The upper edge of the plate, however, at about its mid-length had been stepped, so that a wood rail abreast the house might run with its top at the same level as the bulb angle stiffener fitted on the remainder of the length of the top edge of plate. There was thus an abrupt stoppage of the light bulb angle, in addition to the square cut in the plate edge; the consequent concentration of stresses in this corner fractured the bulwark plate.

It is also found that detached houses well above a shelter deck may acutely feel the straining of a ship in bad weather to the extent that the seams of their wooden top decks will cease to be watertight. These often take up again when bad weather and consequent straining and working of the ship cease. It seems evident that better arrangements on these house tops are necessary; possibly the addition of tie plates would be beneficial.

Another position in which house tops do not receive sufficient care in design occurs alongside the engine casings. It is common here to attach beam ends to the engine casing side by simple lugs, or even by a strap piece bent at right angles, with a couple of rivets each way, the rivets through the casing side sometimes being so far from the beam that the connection lacks stiffness. A wood deck on such supports certainly does not get fair play, and would give much more satisfaction if a tie plate with angle to casing side were fitted fore and aft on top of the beams before laying any wood. The beams, too, would probably be better if somewhat stiffer than usual in such positions, and if fitted with small knee brackets. The writer's views on this matter are strengthened by his knowledge of the case of a ship in which such a deck is quite satisfactory on one side of the ship and is very unsatisfactory on the other side; on the satisfactory side a steel bulkhead parallel to the casing forms an intermediate support for the beams, while the beams on the other side of the ship have no such support, there being on that side only a wood bulkhead. This plainly points to lack of stiffness of the beams as one of the principal causes of this deck leaking. There is, of course, not much weight on the deck above, but the beams and their connection evidently take part in the general working of the ship.

Windlasses and Hand Steering Gear

Better provision might well be made for means of closing the chain pipes through the windlass bedplate when a vessel gets away into deep water. If the windlass makers could give us a little higher lip on the chain pipes on the top of the bedplate to enable a canvas coat to be lashed to it and also to the cable, there would be more security against getting unnecessary water down into the chain lockers when the steamer digs her nose into a head sea.

At the present time makeshift methods of covering up the closing plate usually supplied for the top of these chain pipes with Portland cement are sometimes adopted. These methods would be more effective if the plate was so cut as to make a more complete closing and to drop a little way into the chain pipe and rest there on an internal lip.

Most cargo ships with steering engine amidships are still fitted with a hand steering gear aft. This is in practically all cases so slow and clumsy as to be almost useless. In some cases reported to the writer where, through breaking of steering chains, the hand gear aft has had to be put into operation, a smashup of the gear has been the result. Possibly straining during coupling up with the rudder lashing about may have had something to do with the trouble. At the same time the writer was never very strongly impressed by the amount or disposition of material in these gears; the nuts always appear so very weak in proportion to the large screws employed.

Some builders have, in recent examples, abolished these hand gears in favor of an arrangement for steering by means of the after winches, and with a good arrangement this would appear to the writer likely to produce better control of the ship than could be maintained by even a large number of men at the hand wheel, which must really be too slow for effective control, whether the ship is under her own steam or broken down and in tow.

Probably an efficient arrangement of this kind would obtain sanction as an alternative method of steering from the registration societies. This system seems worth working out.

Steam and Exhaust Pipes

Very objectionable methods of carrying steam and exhaust pipes through casing sides, decks and casing tops are still sometimes employed. The worst of these methods is the sandwich joint. A less objectionable method is sometimes employed, but in view of the fact that leakage from this will generally blow onto the plating, this is not much better than the sandwich joint.

This should be employed wherever space permits. The arrangement permits the use of bolts instead of studs and keeps the joints at such a distance from the plating that if a leak has to go uncorrected for some time the plating, at any rate, does not suffer, while the fact that heat is not so readily conducted from the pipe and its contents to the plating also helps to keep down corrosion.

Stoves Pipes

Lack of thought is often shown in the fittings employed for carrying stove pipes through wood decks or wood sheathing. If you inquire regarding this matter in the drawing office or in the yard manager's room, you generally receive a most confident assurance that an excellent system is employed, and possibly a very good sketch may be submitted. If, however, you follow the matter up in the yard you often find that a most rudimentary fitting, consisting of an iron coaming pipe with a narrow iron flange ring, is being fitted by the carpenter. If he is a thoughtful tradesman, and if the flange on the coaming pipe provided by the store happens to be large enough to permit it, he will possibly cut the wood of the deck or the sheathing one-half inch larger than the pipe each side, and if he happens to think of the matter he may put a strip or two of asbestos millboard in the space thus formed. The chances are, however, that if this is a wood deck, there is nothing to prevent the asbestos from dropping through, and the chances are still greater that if the stove pipe passes through a space in which there is a wood ceiling and beam casings below the wooden deck, the spigot will not be long enough to come well through both the deck and the ceiling, so that there is nothing but the thin and easily corroded stove pipe between the hot gases and the space at the back of the ceiling. A really good system requires to be worked out and made universal for stove pipe coamings.

Perhaps no item among the smaller details of ship's equipment causes more trouble during the lifetime of a ship than port lights or scuttles. As a mechanical contrivance the ordinary side scuttle leaves much to be desired. Tightening is effected by a single screw, the balancing reaction at the opposite side of the glass frame being the dead inadjustable support of a hinge bolt. Hence, if the rubber packing is hard and rather thick, the means taken by Jack to cure the leak that is soaking his surroundings with sea water—putting the poker end or a spanner into the loop of the nut and heaving up tight—is likely to result in a serious straining of the glass frame. Another frequent cause of strain is the effect of a gradual filling up by successive paintings of the slight clearance between spigot part of glass frame and inner diameter of the cast iron or main frame. Here Jack never dreams of the cause of the trouble and heaves her up tight—tight enough, but not watertight.

Small Fittings

No care in design will ever make a sidelight absolutely fool proof. They would certainly be more satisfactory if a hinged screw were fitted upon the hinge pin, with sufficient play in the hinge eyes to permit the screw to apply some pressure. The writer thinks this system was at one time on the market, but did not take. A double jointed hinge would be rather better, with a similar screw, as it would not depend upon any play in the hinge eyes.

To withstand blows of seas and pressure from fenders, sidelight frames applied by some builders to forecastle and poop sides should be much stronger, particularly when, as usual in cargo boat practice, cast iron flanges are used.

Any guidance specification, in referring to this matter, might well stipulate a minimum weight of brass for the glass frame and of cast iron for the main flange, as well as giving sections of these parts and thickness of glass.

At normal times the handling of sidelights is a very much cut trade. Orders move from firm to firm on very small margins of price, and the poor policy of cutting down materials to about the minimum that will hang together is followed by some manufacturers, and even by some builders who make their own sidelights.

Summary

A paper of this length cannot by any means exhaust the list of matter requiring greater attention in ship design and construction.

Possibly much that is taken for granted and carried out without question under present practice would not stand criticism if looked into. Take, for instance, a hatch coaming with heavy flange on lower edge. Considered as a girder, its section is appallingly inefficient, its neutral axis is most unsuitably placed, and the edge which has to stand compressional stress is of the poorest form for the purpose, the hollow, half-round molding being useless except to prevent chafing of the tarpaulin, its rivets are not even in shear to enable it to help the plate efficiently.

Recently builders and the registration societies after a royal commission woke up and have applied bulb angle stiffeners to coamings in certain cases, in a position that helps against the compressive stress, both by raising the neutral axis and by adding lateral stiffness to the plate.

Possibly there are other details where equally radical treatment would be justified, and this paper will not have been useless if it leads other members to draw attention to and, if possible, to indicate the necessary corrections for such errors in practice.

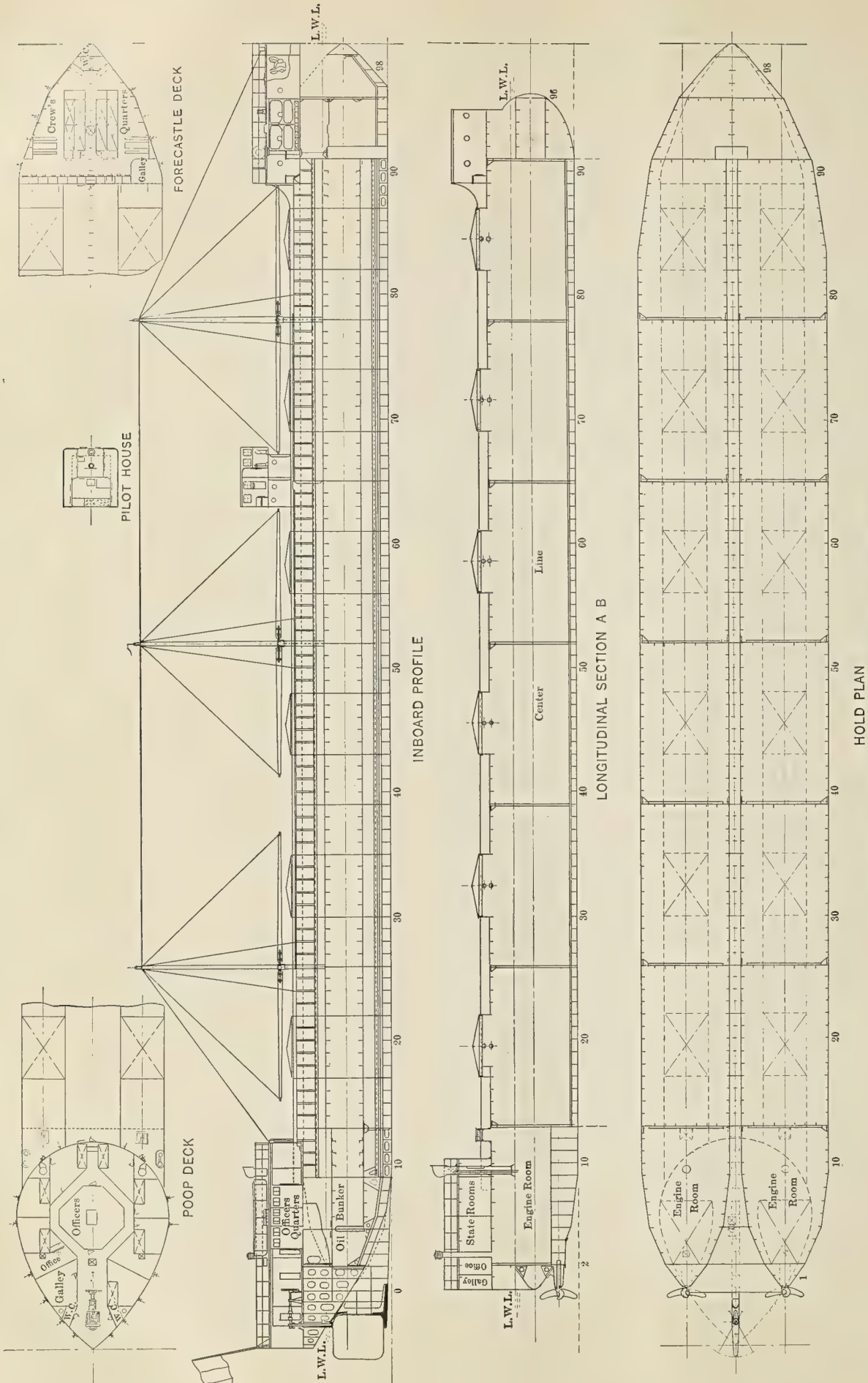


Fig. 1.—General Arrangement of French Unsinkable Ship

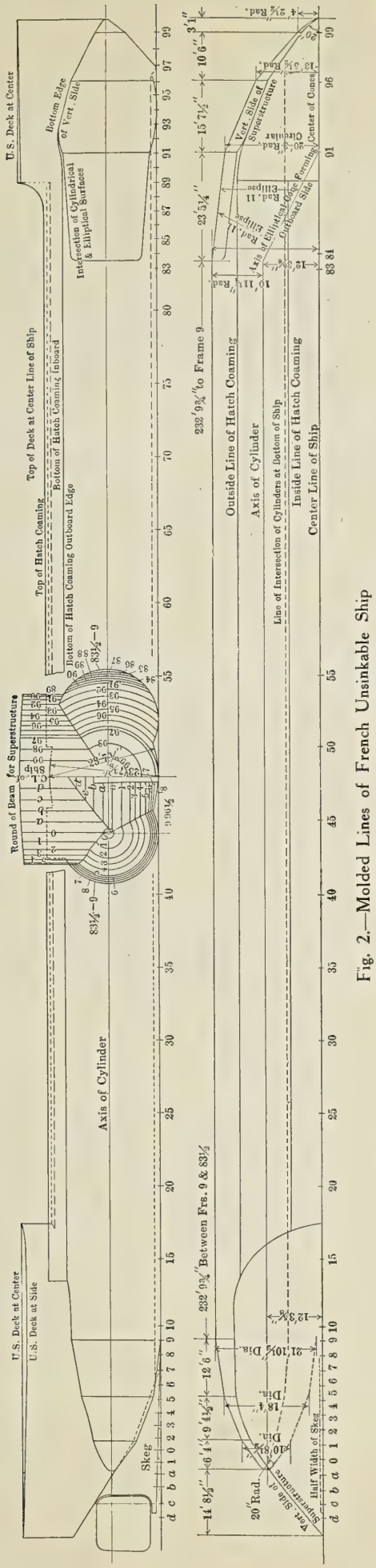

U.S. Deck at Center
Bottom Edge of Vert. Side
Intersection of Cylindrical & Elliptical Surfaces
Top of Deck at Center Line of Ship
Top of Hatch Coaming
Bottom of Hatch Coaming Inboard
Bottom of Hatch Coaming Outboard Edge
Round of Beam for Superstructure
Axis of Cylinder
U.S. Deck at Center
U.S. Deck at Side
Skeg
Between Frs. 9 & 83½
Vert. Side of Superstructure
Center of Cones
Axis of Elliptical Edge Forming Outboard Side
Outside Line of Hatch Coaming
Axis of Cylinder
Line of Intersection of Cylinders at Bottom of Ship
Inside Line of Hatch Coaming
Center Line of Ship
Half Width of Skeg
Vert. Side of Superstructure

Fig. 2.—Molded Lines of French Unsinkable Ship

Unsinkable Freight Ship of French Design

THE problem of constructing a so-called unsinkable ship has been met with in a design which has been subjected to expert naval discussion and approved to an extent that the Foundation Company, New York, has received a contract from the French government for the construction and equipment of five steel cargo steamers of this type. Work on these craft has already begun.

M. La Parmentier, French naval engineer, is responsible for the design, after numerous practical experiments and theoretical study of the stability of floating bodies. Therefore, the term "unsinkable" can be applied to this design in more than a figurative sense, and in undertaking the development of such a design M. La Parmentier was led to adopt the following fundamental principles:

1. That the vessel must be divided into a number of watertight compartments.

2. That the details of the framing should not involve impractical and costly construction.

Conditions Fulfilled in Design

Both of these principles will be fulfilled, it is claimed, by the ships now under construction at one of the Foundation Company's Southern yards. As indicated by the midship section, the vessel consists of two parallel cylindrical hulls joined by transverse bulkheads. The cylindrical shape gives the maximum of hull strength and provides inner walls to withstand the tremendous force of a torpedo explosion.

Furthermore, these walls form two longitudinal watertight bulkheads, strengthened by watertight transverse members, which join the two cylinders and form six centrally located reserve buoyancy compartments. Each cylinder is itself subdivided by watertight compartments.

The experiments made by the French government indicate that not more than two compartments in one cylindrical hull, and possibly two, in the adjoining reserve buoyancy space, would be penetrated by the explosion of a torpedo at the side of the vessel. Assuming that only two compartments in the outside cylindrical portion of the hull were flooded, the ship would list about four degrees. The effects upon the trim of the vessel of flooding first four and then six compartments of one hull would not therefore be serious.

Buoyancy of Ship Maintained

It is said the calculations show that even though one hull were completely flooded, the buoyancy of the opposite hull and the adjoining reserve space would keep the vessel afloat. And even in this condition the ship could be brought into port by the propelling machinery in the undamaged hull, this unit being entirely independent of the engines and boilers installed in the submerged hull.

The La Parmentier designs call for a ship 320 feet long, with cylinders 20 feet in diameter, which will have a deadweight capacity of 4,250 tons on 16 feet draft. Twin-screw steam engines of 700 horsepower each will be installed, and they are expected to give a speed of eight knots when the ship is loaded. Three cargo masts with six cargo booms will be provided, the masts being stepped between the two cylinders, with winches in the fore-and-aft passageway.

An unsinkable ship of practical design would revolutionize the shipping industry, as well as call for a big readjustment of insurance rates at Lloyds. The designs shown herewith may prove a genuine step forward toward the realization of this aim. That it appears at least prac-

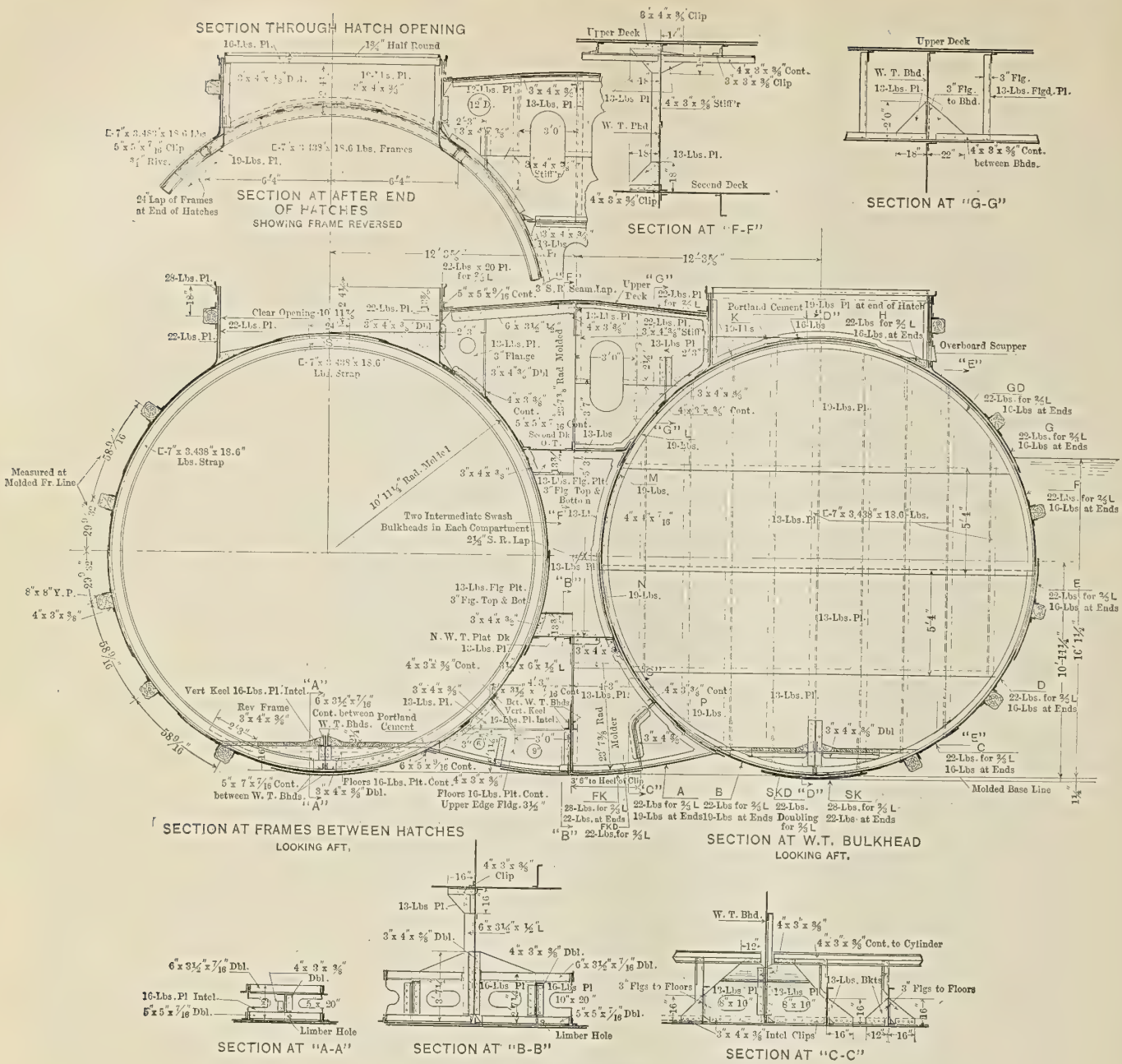

SECTION THROUGH HATCH OPENING
SECTION AT AFTER END OF HATCHES SHOWING FRAME REVERSED
SECTION AT "F-F"
SECTION AT "G-G"
SECTION AT FRAMES BETWEEN HATCHES LOOKING AFT,
SECTION AT W.T. BULKHEAD LOOKING AFT.
SECTION AT "A-A"
SECTION AT "B-B"
SECTION AT "C-C"
Two Intermediate Swash Bulkheads in Each Compartment
Molded Base Line

Fig. 3.—Midship Section

ticable is evident in that the French naval experts have accorded it a considerable measure of enthusiasm. The results should be followed with interest by the whole shipbuilding world.

Pneumatic Riveting and Rivet Shortage

WITH regard to the reduced rate of output in merchant shipping, one of the chief causes is the shortage of riveters, a condition which, it is urged, could be overcome by the wide use of pneumatic riveting.

According to information recently received from one of the leading East coast shipyards, the best day's work on a shell with pneumatic riveting is 700 rivets of seven-eighths of an inch diameter, and for hand work, under the same conditions, 430. An average day's work, however, is considerably less than this, and may be taken as being 510 rivets with pneumatic riveters against 264 with a hand squad, the figures being taken for work on all parts of one ship.

The greatly increased output of work secured by the pneumatic tool is in itself sufficient to establish its enormous superiority over the hand method. But it has another very important advantage in that the pneumatic tool requires fewer men to work it. A hand riveting squad consists of three men and one or two boys, and from two of these squads three pneumatic riveting squads can be formed, effecting a saving of fifty percent in labor alone. A third advantage of the pneumatic tool is that it gives both the other great advantages with less exertion, and consequently less fatigue on the part of the men. The United States yards, by their almost universal employment of pneumatic riveting tools, have been able to overcome their shortage of skilled labor.

Chairman Hurley, of the Shipping Board, and Charles M. Schwab, Director General of the Emergency Fleet Corporation, have appealed to Marshal General Crowder for deferred classification for most of the vast army of shipworkers who registered under the new draft. They argue that these men are essential to the success of the shipbuilding programme, and that shipbuilding is ranked first in its importance to the prosecution of the war.

The Heavy Oil Engine*

Discussion of Factors To Be Considered in Design—Small Demand as Yet for Heavy Oil Types—Future Possibilities

BY CHARLES E. LUCKE†

THE heavy oil engine is of particular interest these days because those who are familiar with the problem believe a change is coming in the situation. It is my intention to present, in a more or less informal way, some of the ideas involved in the development up to the present time and also those which lead us to believe that a change is about to take place, and in about what direction. What I say is somewhat in the nature of a prediction, although he is a bold man who undertakes to make a prediction on these matters. Nevertheless, I am inclined to have a little more confidence than usual, because about a year ago I talked to you here about aeronautical engines and showed those who were not already familiar with that fact from what a chaotic state the art of aeronautical engine construction was then emerging, and ventured to lay down some general lines of practice that seemed to be proper and a good basis for future work to follow.

Since that time this country has been drawn into the great war, and, likewise, since then the Liberty motor has been designed and put on a manufacturing basis. A good many ideas that were presented a year ago before the inception of that motor, and before there were standards of any kind, have been incorporated in it. A number of the things which were then not standard and which were recommended as standard have since become standard.

I feel, therefore, somewhat more confident in the sort of prediction to be made to-night on the heavy oil engine.

Internal Combustion Engine for Navy

It may be of interest for me also to say here that, as a result of the war, my entire time, to the exclusion of all other things, has been devoted to the subject of internal combustion engines for the navy service. The Navy Department has established at Columbia—about the Mechanical Engineering Department, as a nucleus—the official United States Navy Gas Engine School, and over 900 men have been given, all without any internal combustion experience before they came, a four-weeks' finishing course of training and have been turned out into the service. Of those men, the leading engineers of over 200 of the submarine chasers form a part. That work is now going on and will continue until all these boats have been manned with trained men.

It is interesting to note, also, that these boats were non-existent a year ago; they did not even exist completely on paper, and before a year will have passed from the time when they were paper things there will have been completed, and in the water and completely manned and officered by trained men, over 300 of them. Even though that is a small matter in the naval programme, it is nevertheless an accomplishment that all ought to feel proud of.

The gas engine school at Columbia University is also now undertaking to train the engineers and leading mechanics to take charge of the motors for the navy foreign flying base station service. I mention that because I want something from you in that connection; to help secure fine, competent internal combustion engine men who are also machinists, and therefore the kind of men that can safely be trusted with the enormous responsibility of proper maintenance of an aeronautical motor, the failure of which may cause the sacrifice of life. We will not undertake to train any man who is not at the start a pretty good man—at least from the experience standpoint. We are not finding these men at the present time as fast as we need them, so I am mentioning this fact with the idea that those of you who are here and who know such men will let me have their names, or at least tell them to apply for that class of service, if they like it, and I will see what can be done to bring them in. The leading men will receive the rank of ensign in Class 5, the Naval Reserve Flying Corps, and will have the job of engineer officer.

Possibilities of Heavy Oil Engine

To return to the subject, the heavy oil engine. The heavy oil engine in this country has never amounted to very much. That fact itself should prompt some inquiry, because this country is the home of petroleum.

The heavy oil engine as an internal combustion engine has so far proved itself to be capable of the highest known thermal efficiency in transforming the heat of combustion into work. Efficiencies approaching 40 percent are normal, and in some rare cases this is exceeded. This is not equaled by any other system that has ever been produced.

Putting those two facts side by side, you will see a cause for wonder at once. Here is America producing more petroleum than any other country in the world, and doing it for a long time back—something like fifty years—and yet the motor that operates with this oil—the most efficient known—the heavy oil engine in this land of petroleum is, compared with other classes of machinery, practically a failure. It is a failure in the sense that the business of producing it has not expanded materially, and it has been in general an unprofitable business. No one in this country has made much, if any, money in building oil engines, and a great many who have thought of going into the business with excellent prospects, good plans and plenty of capital behind them finally decided not to do so on the record of failure to produce dividends on the part of those who are already in.

The Commercial Demand Small

There has been from the beginning great interest in the oil engine. It is a thing attractive to the mind. Everybody thinks about it. And yet, on the commercial side, there has been very little demand—not sufficient demand anywhere to warrant any really large establishment confining itself to the production of oil engines with a competent engineering staff and research department such as would be necessary to do the thing right. This lack of demand is rather difficult to explain, but it is nevertheless real. Assume it to be a fact, without investigation, and put it down as the first of the various causes for lack of development. The next cause is the fact that this is the land of petroleum, and therefore the land where petroleum and its products are held in least value. In other words, we are prodigal of petroleum and have not the induce-

* Paper read before the Engineers' Club of Philadelphia, January 29, 1918.

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ment, by reason of our multiple supply, to economize it. In the place where oil is so plentiful, naturally it is not regarded as a valuable product—not nearly so much as in a distant country, where its cost is high. That fact makes the high efficiency mentioned before lose its attractions, and when it is remembered that the machine to produce this high efficiency is a costly machine, therein lie the elements of financial balance that turns the wrong way.

The cost of power, when it is the controlling factor—and that is usually the case in stationary installations—is made up of two charges: fixed and operating. The fixed charges are based primarily on the first cost of the engine, and the heavy oil engine has always been an expensive engine—never less than 60 dollars per horsepower, and often as much as 80 dollars per horsepower. On the other side is the operating expense, the principal item of which usually is the cost of fuel. The more highly efficient is the engine, in fuel consumption, the less will be the fuel cost per horsepower hour, and therefore the more prominently this heavy fixed charge will stand out.

In all cases where the cost of power is the controlling factor these financial facts are to be laid beside the fact of the lack of demand for these oil engines. Nevertheless, as time goes on, inventors, designers and research men are not deterred from trying out schemes, so that, in spite of this lack of financial and business encouragement, there is a very considerable degree of progress—much slower than it ought to be, but nevertheless real. Unfortunately, in this case the public in general is not informed about this progress, and therefore when, due to a change in economic conditions, the time comes to make use of all the available information on the subject, we suddenly wake up to the fact that it is in the hands of a few people, and the rest of the public knows nothing about it.

Time for Activity

The present is a time of change, and there are two reasons for that. In the first place, the war has brought about a shipping situation which is unprecedented in the history of the world. There is a demand for ships to-day such as never existed before, but there is at the same time just as real and as strong a demand for the men to run those ships. The heavy oil engine is one of the various possible ways of driving a ship, providing the ship be not too large. Its fuel economy is a direct value in ship operation, since it gives a larger cruising radius or the maximum possible cargo capacity. It furthermore is peculiarly adapted to a ship, in view of the fact that we are facing a labor shortage in ship operation, and the heavy oil engine ship can be operated with less men below deck than any other type of vessel ever produced—except, of course, the small gasoline boat. The war, then, has brought to our attention this heavy oil engine as a possible motive power for the smaller of these new merchant vessels as well as naval vessels, though more merchant than naval. And it is a fact that shipping people are considering this question to-day all over the country, but most of them are afraid to act. They would like to, as near as I can find out by talking to them, but they are afraid to act. To my mind the time is not far distant when they will have to act, or lose something by not acting.

Aside from the shipping situation, there is another reason, and that is the economic reason of an appreciation of the value of this wonderful fuel that Nature has placed beneath our country's land surface. This fuel is peculiarly adapted to this sort of use: the generation of power in internal combustion engines directly, with the highest possible efficiency and the least possible man attendance. Fuel has been wasted in this country, especially in that region near the oil fields, just because it was plentiful. Nevertheless, we are coming to the point when the people—if not the people, certainly the Government—will be compelled to force the abandonment of the use of this fuel for all purposes where other kinds of fuel that can be had in more plentiful supplies would do as well. When you consider that oil or petroleum is the only kind of fuel that can be used in the high efficiency engine, then it becomes clear that to burn it to warm a living room where charcoal or wood or coal of any grade would do quite as well is to commit a sort of economic crime. That feeling and the financial consequences of not acting upon the realization of that situation will come to a climax before very long and result in a plan for conservation of our liquid fuel or petroleum supply, so that it shall be used for only those purposes for which it is peculiarly adapted and be barred from all other uses where other things will suffice. In the natural course of events people wait for prices to bring such a situation about, but this is not a time that properly is classifiable as belonging in the natural course of events. This is a time which is distinctly abnormal and unnatural. We hear every day plans proposed and turned down because there is no precedent, with always the rejoinder that here we are in a great war for which there is no precedent, so why follow precedents in other things? We have been forced to change in a thousand and one things, so let us change in a thousand and two things, and do it quickly.

I could expand to considerable length along the lines of the economic situation with regard to the use of oil and the peculiar adaptability of oil in the internal combustion engine, and the particular adaptability of that class of engine to the ship service, but I want you to realize that there is another field also where there is a demand slowly but surely growing up, and that all these separate demands, coupled with the growing change in the economic situation, must certainly, one piling on top of the other, produce a new condition which I foresee.

Difficulties in Automobile Industry

We have a real gasoline (petrol) automobile industry, and it is becoming a great manufacturing industry, but it is to-day tied up to and inherently dependent upon the lighter petroleum distillates. There is no highly economical gasoline (petrol) or kerosene (paraffin) engine, and every reason leads us to believe fundamentally that none can be produced on the present system. To make our automobiles and motor trucks and tractors run, and to make our available sources of fuel supply last, there seems to be only one solution, and the leading engineers and mechanics in the automobile industry are beginning to talk about that solution: the adaptation of the heavy oil type of engine to the high speed class of service which such as the automobile and the tractor require. It is coming; there can be no question about it. If anybody is able to-day to produce the high speed type of engine necessary, even though it costs more money to build, rest assured it will be adopted very quickly.

There is a third field, and that is the field of direct-connected electric generating sets. For a long time in the gas engine business we built engines to drive generators in a kind of haphazard fashion. As time went on a particular type of outfit began to appear—a direct-connected, high-speed generating set, with engine and generator on one base, self-contained, the best example of which, on a small scale, is the Delco lighting outfit, which is being sold at the rate of over 50,000 sets a year now all over the country districts. There are corresponding units of other designs

in larger sizes. The fact that these sets are generally confined to gasoline (petrol) limits their use, because in many places gasoline (petrol) is unsafe to use; in other places it is not obtainable; in still others the cost of it is prohibitive. It is apparent that if we had the heavy oil engine adapted to that class of high-speed, multi-cylinder service, and with the necessary degree of regulation, it would open up still another field.

So in the field of application of the heavy oil engine I see just ready to be invaded these three things: First, a widened use for ships; second, a new use in the automobile type of motor; third, a corresponding new use for direct-connected, high-speed electric generating sets. Whether they be used on land or aboard ship, it does not matter. If they are designed right they are serviceable in either place.

It is of interest, and particularly pertinent here, to review some of the ideas that have been developed to date, and some of the suggestions available as lines of possible development in the direction of real progress. And this review I divide, for the purpose of clarification, into two topics—functional and structural.

Functional Discussion

Under the functional come all those questions connected with the supply of air, the supply of oil, the establishment of the proper relations between the oil and air to give the desired control of combustion after the necessary compression—in fact, all those physical processes involved directly in the development of the power within the cylinder.

Under the head of structural would come all those principles of type arrangements or typical part forms, and proper proportions of the metal structure that houses these physical processes and there produces a machine.

The first item under the functional discussion is that of charging the cylinder with air, and this is carried out by either the so-called and well-understood 4-cycle system of two valves per cylinder, or by any one of several 2-cycle schemes. Of the 2-cycle schemes there are a number. First we have the ordinary crank case precompression chamber, which is barred from any engine of more than diminutive size, because the closing of the crank case prevents access to the working parts, in addition to imposing other bad conditions. The first step in avoiding the difficulties of the closed crank case, which are prohibitive in any real engine, comes when the connecting rod and crank shaft are left open and the front end of the cylinder closed, the front end acting as a precompression or air-charging chamber in conjunction with an air reservoir, which is necessary, so that the pressure in the front end of the cylinder cannot rise too high.

Faults of Front End Compression

This front end compression arrangement has certain faults that have led to the design and more wide use of others. For example, it is not possible in the oil engine of the 2-cycle sort, with the front end precompression chamber, to put into the motor end a volume of air equal to the piston displacement; the volume must necessarily be less than the piston displacement measured at atmospheric pressure. That being the case, some of the burned gases or products of combustion cannot be expelled, and, at the same time, the residue is hotter than it otherwise would be. To correct that, the alternative schemes of a step piston or a separate scavenging pump have been developed, more particularly the latter. The step piston is the first of the scavenging schemes, and is a scavenging scheme because the volume swept through by the step of the piston may be made larger than the volume swept through by the motor piston proper, and the excess of this displacement is the scavenging displacement. By means of it more air can be put into the motor cylinder per charge than can possibly stay there at atmospheric pressure. This being the case, the burned gases may be more completely expelled, and, what is much more important, the residue of the gases left there would be much cooler before the next compression starts.

This step piston has certain faults of a structural nature which need not be detailed, but which are responsible for the wide use of the alternative scavenging scheme of a separate low-pressure compressor, built somewhat along the lines of the old-fashioned blowing engine. This arrangement is usually double-acting, so that one such scavenging pump will serve two single-acting, 2-cycle motor cylinders. With it the 2-cycle engine can then be made to perform all the things that the 4-cycle engine can do, except as to the negative work involved in the precompression of that surplus air, so that, while the two engines may perform somewhat the same, the 2-cycle form will be necessarily less efficient by the lost or negative work, and, at the same time, some of the so-called simplicity of the 2-cycle engine has disappeared. So completely has it disappeared that it will be found that the weight per horsepower has grown in the 2-cycle to be substantially the same as the weight per horsepower in the 4-cycle. That is to say, when you start with the simple 2-cycle idea with the hope of getting half the weight per horsepower, because of twice the number of impulses from the same amount of metal, then you have to add this and that and the other thing, and by the time you have got through adding enough to make it a real working engine the weights of both types are just about the same. Therefore, the 2-cycle, as compared with the 4-cycle as to weight, might be called substantially equal. But there is an inequality in another direction. The 2-cycle, acting with more impulses per minute in the same volume, will run hotter and load the same sized bearings to a higher average bearing pressure, and, as a consequence, size for size, the 2-cycle will give more trouble with burnt pistons and overheated bearings than the corresponding 4-cycle.

Personal Opinions

These are a few of the reasons why this much-mooted question of 2-cycle versus 4-cycle as a means of air charging remains a controversial matter, rather than one of settled engineering practice. My own personal opinion about the matter is this: That in the smaller size, let us say up to 100 horsepower or 200 horsepower maximum, the simpler form of 2-cycle, not with the separate scavenging pump, is a rather good thing and practical. In the next range of sizes, from, let us say, 500 horsepower, the 4-cycle works out best in the long run, and from that point up the pendulum swings the other way toward 2-cycle with scavenging pumps as matters stand to-day. But in the larger sizes the art is most undeveloped, and most of the uncertainty as to what is the proper engineering practice concentrates right there.

The next item under the functional discussion is the introduction of the oil, to form either an explosive mixture for explosive combustion or to prevent the forming of an explosive mixture so that the oil may burn non-explosively. Before examining the means of introducing and controlling combustion of the oil, I want to point out the fundamental and controlling value of a compression before injection on the one hand, and of the rate of oil burning following the right amount of compression on the other. Consider the former point first. It can be demonstrated, and it is pretty generally understood now

without demonstration, that, other things being equal, the more the air charge is compressed before the introduction of the oil the higher the mean effective pressure will be; and that, of course, is a prime factor in power and, at the same time, the higher the efficiency, or smaller the fuel consumption. It may therefore be said with practically no reservation that in an oil engine as much compression should be carried as is possible. But that is not all. After the compression has been completed the oil must be introduced either at that time or just previously, so as to produce a suitable and proper combustion line of one of the two characteristic types or mixed.

The two characteristic types of combustion line are, first, the vertical combustion line produced by an explosive mixture, and, second, the horizontal combustion line produced by a gradual introduction of the oil, the oil burning as it comes in, and which latter system has been called the Diesel system. It is clear, of course, that we might burn part of the oil explosively, raising the pressure a fraction of the maximum, and burn the rest non-explosively, without further change of pressure. Or we might have such a slow introduction of oil as to cause the combustion line to drop as the piston moves out on the working stroke. The two types of combustion line are (*a*) the vertical explosive, and (*b*) the horizontal non-explosive, or Diesel, forms. Now, of these two methods of oil combustion as to rate, which should one choose? That question should be settled before considering the means of introducing the oil, because one is not warranted in spending time in determining how to introduce the oil until there is first a decision as to what end is to be accomplished by it. In other words, we must establish the specifications before undertaking construction.

Comparison of Diagrams

It will be found, by comparing the full diagrams for those two combustion lines, with the same amount of oil and expansion, of course, following both, that about the same mean effective pressure is possible with both or with either. That is to say, so far as power is concerned, there is no choice. But, on the other hand, when you compare efficiency or fuel consumption, then this startling fact comes out: That the constant pressure or Diesel kind of non-explosive combustion is capable of only half the efficiency of the other kind of combustion, the explosive sort. To put it a little differently and more precisely, if the fuel be burned explosively after compression, then an efficiency can be produced with a corresponding fuel consumption equal to that obtainable with the non-explosive Diesel combustion when the latter has twice the compression of the former. Again, to put it in still another form, a Diesel diagram with nearly 500 pounds compression produces no better efficiency or fuel consumption than an Otto cycle diagram with 250 pounds compression. There is, therefore, absolutely no doubt on fundamental ground as to which of these two possible modes of burning offers the best promise of results. They are equal in power possibilities and nearly two to one in efficiency with reference to compression. When I say the latter, do not misunderstand. Do not think I mean to assert that the Otto can give and always will give twice the efficiency of the Diesel—not at all. They can be made exactly equal in efficiencies and fuel consumptions with selective compressions, but when the compression is thus selected to do that thing it will require twice the compression with the Diesel as will be required with the Otto arrangement.

This is particularly interesting when you consider that fully 90 per cent of all the development work that has been done with this heavy oil engine has been done with the less promising Diesel cycle, and the very promising Otto cycle has been almost entirely neglected. I say it has been neglected, and yet I do not mean that. It has been neglected by those people who understood the possibilities—the students of this subject. It has not attained the popularity or the standing in a commercial way of the Diesel.

In this functional study the next important consideration is the compression itself, and the relation between the degree of compression and the mode of combustion, or control of combustion. The oil has to be ignited, and there are various ways of igniting it. It must not, however, be ignited until the right time comes; that is, not until a sufficient degree of compression has been executed —whatever is desired. Therefore there must be an igniter, and the ignition, as a process, must be under control. Now, the ignition will always take place whenever any fuel in contact with air reaches the ignition temperature. The air under compression is rising in temperature and is approaching or passing the ignition temperature in that process of compression. Somewhere or another in the process of compression, if it be carried far enough, ignition temperature will be established and ignition will inevitably occur, if there is any oil in contact with the air.

It is therefore essential, in considering the limit of compression in its relation to the introduction of oil, to have some kind of mental picture, and preferably exact figures, as to the way in which the temperature rises in compression, especially with reference to the ignition temperature as a basis of reference.

Introducing Some Tables

The ignition temperature of these heavy oils is a somewhat uncertain physical constant, but from my experience I am inclined to think this is very close to 950 degrees F., or near enough to that for practical purposes.

To bring this matter before you, I have prepared a little table here (see table below). This table shows at the left, first column, initial air temperatures of from 200 degrees F. to 600 degrees F. before compression. Starting with these temperatures, then, to reach ignition temperature it would be necessary to have the compressions indicated in columns 2 and 3. To reach temperature of 200 degrees less than ignition temperature the compression would be as shown in columns 3 and 4. To reach a temperature of 200 degrees F. over ignition temperature, the compressions required are shown in columns 5 and 6. Or, for 400 degrees F. over ignition temperature, the compressions of columns 7 and 8.

COMPRESSION VERSUS INITIAL TEMPERATURE VERSUS IGNITION TEMPERATURE (±)

	Compression, Pounds per Square Inch Above Atmosphere (14.7) with 0.1 Pound Valve Drop							
Initial Temperature	Ignition Temperature of 950 Degrees F.		200 Degrees F. Below Ignition		200 Degrees F. Above Ignition		400 Degrees F. Above Ignition	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
200	190	293	104	152	305	511	467	800
300	110	155	58	79	181	279	282	460
400	67	92	34	42	114	165	175	275
500	41	52	18	22	75	101	118	174
600	23	31	8	10	47	63	79	107

Based on $S = \begin{cases} 1.33; \\ 1.40; \end{cases}$ $P = 14.6 \left[\left(\frac{T \text{ final}}{T \text{ initial}} \right)^{\frac{S}{S-1}} - 1 \right]$

To explain further, starting with atmospheric air at a temperature of, say, 70 degrees F. in an engine room, it is drawn into a cylinder and is bound to become somewhat heated on its way. It will become heated by contact with the hot intake ports, sweeping over the intake valves,

sweeping against the interior cylinder walls, which are very hot, especially in large engines with thick metal, and finally it mixes inside with the hot products of combustion from the previous shot. So, to say that this 70 degrees F. will rise 130 degrees F. and have a temperature, therefore, of 200 degrees when compression starts is a very moderate estimate. It is never less than that, and that is the reason I have made this the minimum figure. It might easily be much more than that, especially when it is considered that in some of these engines the interior is red hot in spots. In some of them the whole wall, especially the hot bulb type, is deliberately kept red hot as an igniter. It is quite clear that any products of combustion or air in contact with that red hot spot might easily approach or exceed a temperature of 600 degrees before any compressing is done at all. So I make the temperatures before compression range anywhere from 200 degrees to 600 degrees—and there is even justification for going further.

What Follows When Compression Starts

Now, when the compression starts the pressure follows the general law given at the bottom of the table, and from that certain variations follow; but we are not quite sure as to what value the exponent *S* has, although we do know it cannot be larger than 1.4. We know by experience it is not less than 1.33. So, for each one of these values I have calculated two figures—the compression pressure in pounds per square inch above the atmosphere—and you see here that to reach ignition temperature with 200 degrees initial temperature would require 190 pounds compression minimum to 293 pounds maximum—actually somewhere between; it is difficult to fix it any closer. Whereas, if the initial temperature was 600 degrees, then the ignition temperature would be reached in that same cylinder with a compression of only 23 pounds to 31 pounds. That brings out in the most striking fashion this fact: That if the fuel is in contact with the air in the cylinder during compression, then the amount of compression cannot be very large in any case without producing an uncontrolled pre-ignition. And, more important still, if any part of the oil and air is very warm before compression starts, then practically no compression can be carried at all. And, if you cannot carry much compression, then you have a very high fuel consumption and a very low efficiency. An engine carrying such low compressions as are here required would burn nearly 2 pounds of oil per hour per horsepower, whereas the best engines are to-day running on about four-tenths of a pound—a ratio of five to one.

Now, suppose an igniter that was itself under control, and fuel in contact with the air in the cylinder. How much can we compress it without any danger of pre-igniting it, so that when we want to fire it can be fired with the igniter that is under control? I suggest that 200 degrees margin is about as good as can be estimated. Let us limit the final compression temperature to something like 200 degrees under the ignition temperature, in which case these are the allowable compressions: With 600 degrees initial temperature, the final compression pressure is 8 pounds to 10 pounds; with 200 degrees initial temperature, 104 pounds to 152 pounds (see table).

On the other hand, suppose that the system was such as the Diesel, where the air temperature itself is to serve as the igniter. In that case, to insure ignition, we should have a margin of about 200 degrees in the other direction; that is to say, the air should be compressed to a sufficiently high pressure not only to produce ignition temperature, but 200 degrees more, in which case the last two columns give the compressions that are necessary. Should the oil now be introduced into the cylinder by means of compressed air to make a fine spray and scatter it through the charge of air, in accordance with the general practice, then it must be remembered that this air jet which is doing the spraying and the scattering is itself exerting a cooling action. Consider 1,000 pounds or 1,200 pounds pressure of air expanding through the spray valve into a cylinder with about 300 pounds or 400 pounds or 500 pounds compression pressure, and it can readily be seen that there is a very considerable cooling action right at the jet. That it will act to prevent ignition and to make sure that the oil will ignite in spite of such cooling influence at the point of oil injection, it is necessary to carry the compression still higher. Let us provide at least 400 degrees over ignition temperature, in which case, with an initial temperature of 200 degrees, we would require something between 467 pounds and 800 pounds compression. With 600 degrees initial temperature we could secure this 400 degrees above ignition with anywhere between 80 pounds and 100 pounds compression.

These figures should be made the subject of some study and be used in considering the various structural arrangements, because in them will be found a key to the question: Why cannot this type of engine—this arrangement—be efficient? And why is the other arrangement highly efficient? Here also will be found the key to the question of how we should proceed to make the less efficient one more efficient. These three elements stand out:

First, is the fuel in contact with the air during compression, or is it not?

Second, if the oil is in contact with the air during compression, is the region of contact all of low temperature, all of high temperature, or any part of it a high temperature region when the compression starts? The initial temperature has a great effect on the degree of compression needed or permissible.

Third, if the oil is not in contact with the air during compression, but has to be introduced subsequently, how should it be introduced with reference to the igniter? If the air itself is to be the igniter, then a certain high value of the compression must be obtained, or the engine will not run. If the air itself is not to be the igniter, then what kind of an igniter can we provide? We will look into that question.

All the first oil engines to attain commercial success had vaporizers. That is to say, there was some element the duty of which was to heat the oil alone for later air mixing, or to heat the oil and air together, to produce a vapor air mixture. It matters very little as to what were the details of those arrangements—whether one produced a heavy carbonizing action and another did not. They are all one as regards this point of controlling importance: The mixture when formed by any such vaporizing system is necessarily a warm or a hot mixture. Just how hot it has to be depends upon the vapor pressure of the particular oil, or rather the heaviest constituent of that particular oil, and I will give some figures to make it clear. A 60-degree Baumé gasoline vaporizing in air requires a temperature of about 100 degrees to 110 degrees. The ordinary lamp kerosene of 150 flash point vaporizing in air requires a temperature of 250 degrees. A navy fuel vaporizing in air requires a temperature of 420 degrees, and so on. One could go on with any grade of oil or residue; for each there is some temperature at which the vapor of the oil can be produced in the right proportions for combustion and in contact with its air, without residue and dry.

(*To be continued.*)

Concrete Boats Built by the Aberthaw Construction Company

WITH an experience of twenty-five years of reinforced concrete construction behind them, the Aberthaw Construction Company, Boston, Mass., has entered the marine field and established a concrete shipbuilding yard at Fields Point, Providence, R. I.

The vessels now actually under construction are 500-ton lighters, with plans under way for others of larger and different type. The lighters now in the building are 112 feet overall, with 34-foot beam and 11 feet 6 inches depth. The draft, empty, is 3 feet 9 inches, and, fully loaded, 9 feet.

The deck of the lighter, which is without camber, is designed for carrying coal or a similar cargo and is constructed to take a uniformly distributed live load of 500 pounds per square foot, while the compartments themselves are well adapted for handling fuel oil. Each of the fifteen compartments is fitted with a hatch set in an iron frame furnished with rubber gasket and suitable provision for battening down. To assist in holding the deck load, a timber bulkhead is built enclosing an area of 90 feet by 30 feet. The side bulkheads are 2 feet high and end walls 5 feet in height.

The outside shell and deck are each 3 inches thick and reinforced with round deformed bars of the corrugated or Havemeyer type. The bottom slab and frames are de-

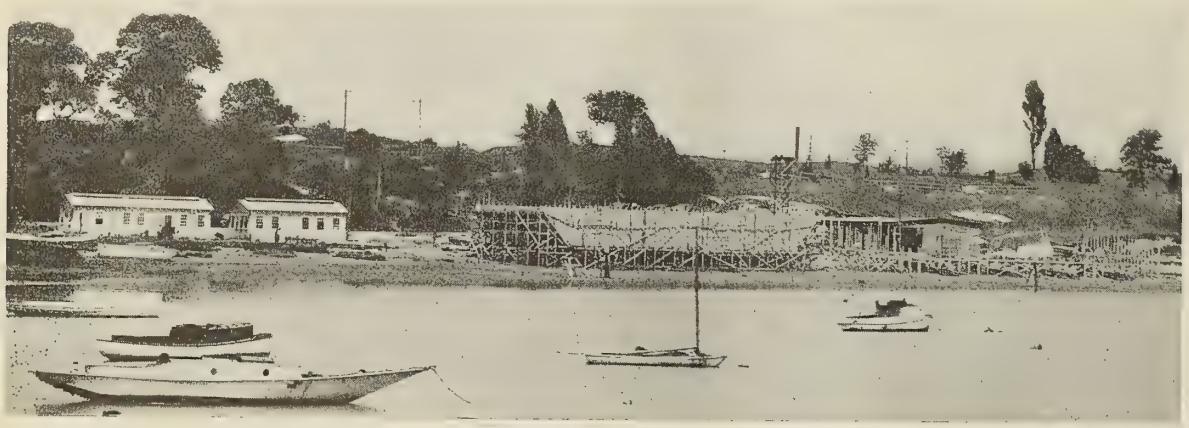


Fig. 1.—Yard of the Aberthaw Construction Company

The general shape of the barge is that of a rectangular box with the bottom sloping upward at each end and the corner formed by the junction of the sides and bottom rounded off to a 6-inch radius. Four transverse and two longitudinal bulkheads divide the lighter into fifteen watertight compartments of approximately equal cubical capacity.

signed to carry an upward pressure of water equal to a head of 11 feet 6 inches, and the side walls and frame are designed on the assumption that the water might be flush with the deck. The sides and bottom are painted on the outside for greater impermeability, and the sides and ends are protected by hardwood fenders and chafing strips. The decks are granolithic finished.

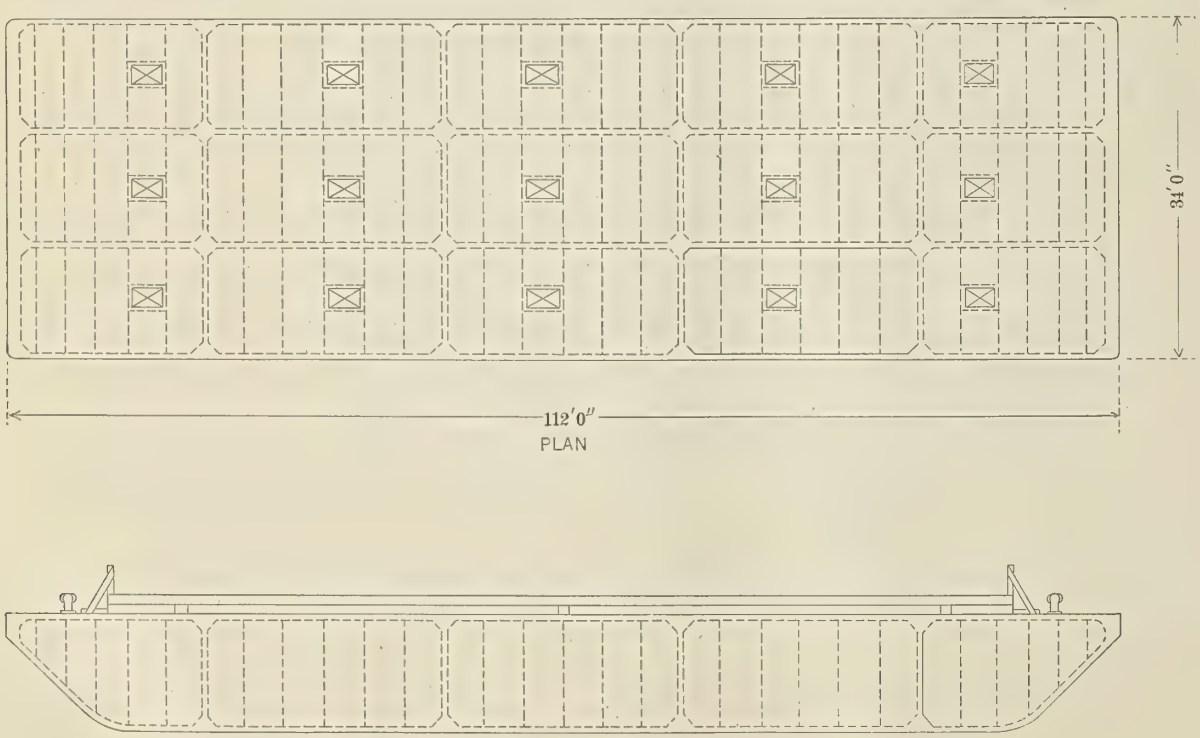


Fig. 2.—Plan and Elevation of Aberthaw Concrete Boat

All steel used for reinforcing is of mild structural grade, that used for the longitudinal girders being in one continuous length, butt-welded where necessary, care being taken that the welds are staggered, so that no two welds are within 40 inches of each other. The bars for the transverse frames are made continuous in like manner. All intersections of bars are fastened with soft annealed wire, which is wrapped around and tightly twisted.

The concrete is mixed in portions of one part Lehigh Portland cement, one part sand and two parts stone, the cement being of such a grade that ninety percent will pass through a No. 200 sieve, no aggregate being used exceeding a size that would pass a ⅝-inch ring; the sand being sharp, clean, bank sand, free from all dirt or vegetable matter. Each barge requires 500 barrels of cement, 75 cubic yards of sand and 130 cubic yards of ½-inch stone, together with approximately 44 tons of reinforcing rods ranging in size from ⅜ inch to 1⅛ inches.

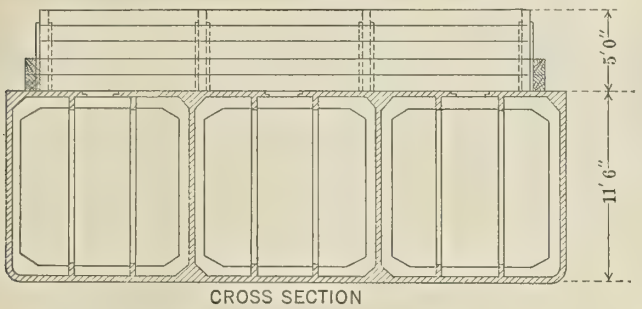


Fig. 3.—Midship Section

The barges are fitted with cast iron chocks, cleats and bollards, the majority of the balance of the hardware used being galvanized. Bitts and fenders are of oak, the remainder of the woodwork being hard or long leaf yellow pine, dressed on four sides. On the sides at either end is the "Aberthaw A" in brass, a mark that represents twenty-five years' experience in reinforced concrete construction.

Take a mailing tube, say, 18 inches long and two inches diameter. Put your mouth at one end and blow through it and feel the effect of the blast on your hand at the other end. Now hold the tube about an inch from your mouth and blow into the end of the tube. You will be surprised to feel the increase of the effect at the other end.

This experiment illustrates the principle of the Jeffrard injector, brought out by that Frenchman in the fifties of the last century. The scientific world called him crazy and all said the injector would not work; but it does.

Take this mailing tube and try to twist it, holding it at each end; now slit it from end to end with your knife and again try to twist it. This experiment will give you a better lesson in the value of forms in resisting strains than the best .r chaser can show on one thousand sheets of paper. Just try it.

Men have been known who could put a keen edge on a tool but could not do a job with sharp tools. The tendency of to-day is to find out what a man can do best and keep him at that job. In war times this is not only wise but necessary. In times of peace a single operation man makes for low mentality, and low mentality is a detriment to an individual and to the nation. Low mentality is not governed by reason but by personal comfort. A well-fed mob soon fades away. The agitator knows that the way to set a crowd doing things is to point out what they want, to tell them where it is and to go and take it.

Admiral Sims Urges Shipyard Workers to Speed Up Construction

VICE ADMIRAL SIMS, commanding the United States naval forces operating in European waters, insists that we must have more and yet more destroyers. Do the men who actually build the boats understand how vitally important is speed in building? he asks; do they understand that we will win or lose according to whether we beat the submarine or it beats us; that we must depend chiefly upon destroyers for this—to protect merchant vessels and attack the submarines; that a destroyer is worth nothing while in America; that she will be useless if she arrives here too late; that destroyers on this side now are worth their weight in gold?

Do they understand that if *every single man* could speed up *his own work*, every riveter strike more blows per hour, every handler of machines, metal, tools, etc., save every second of time, we could get our ships in service in very much less time and thus hasten the end of the war?

This applies equally to the great force of men who are building the new merchant vessels. Their work is just as important in beating the enemy as that of the men in the trenches. The soldiers cannot win unless they are supplied with food and guns and ammunition, and this can be done only by ships.

The point is that every man should feel that every blow of his *own* hammer is a blow at the enemy; that a certain number of blows will put the enemy down and out; and that the sooner all these blows are struck the more valuable lives will be saved and the sooner we shall have peace and plenty.

If our yards will rush the ships and destroyers, we may rely upon the Allied navies and armies to do the rest.

Many a man loses interest in his work in the fireroom when he sees that his work is never recognized. A little encouragement is wise. Go down into the boiler room now and then and say a word of appreciation to the man with the shovel. If he is not worthy of it, fire him instead of letting him fire.

Oil in a boiler, all know, does harm, but just why is not usually understood. Oil of itself does no harm on a metal surface; in fact, it is well known to preserve it. However, when oil lies on a metal plate exposed to heat the oil turns into a deposit of carbon and so intervenes between the plate and the cooling effect of the water. It is this condition which destroys the plate.

Years ago alchemists were constantly searching for the touchstone which would turn all metals into gold, or for a universal solvent—a something which would dissolve anything. These men never seemed to get the idea that the more gold there is the less it is worth, or to wonder in what they would keep the universal solvent if they found it.

A fireman who had been at sea applied for a job of running a boiler in an apartment house. He said to the owner, "Although my hair is gray, I am as fit as ever I was, but most men don't want a gray-haired man around."

The proprietor replied, "I hire a man for what is in his head, not what is on it."

That was a wise man indeed.

I can call spirits from the vasty deep. Oh, but will they come?

I can drive rivets by the thousand feet. Oh, but will they stay?

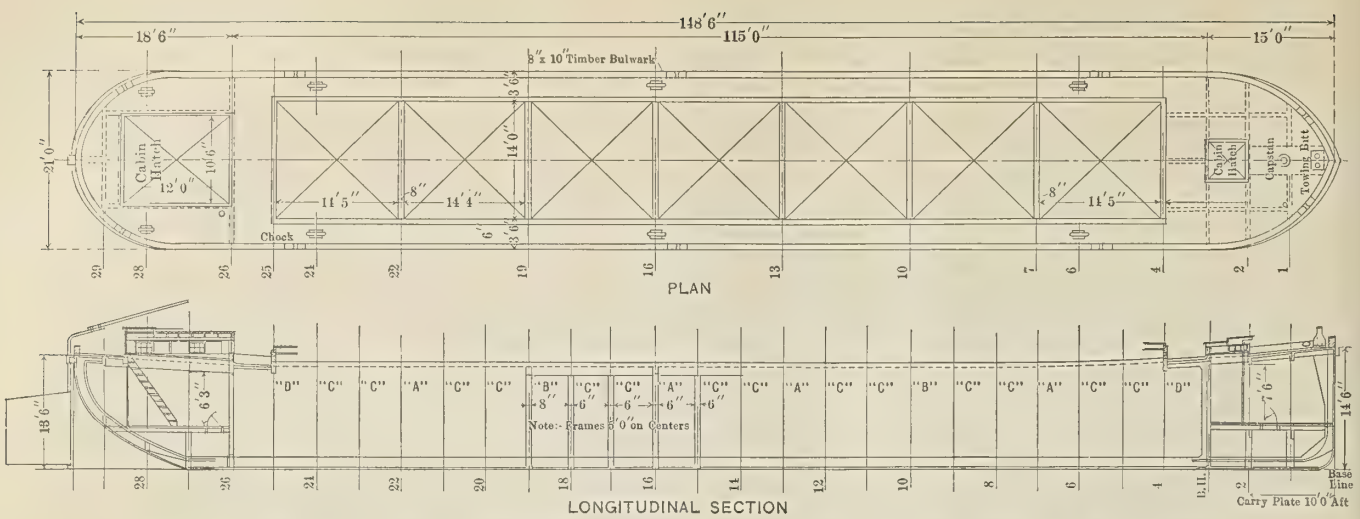


Fig. 1.—General Arrangement Concrete Barge. Length, 150 Feet; Beam, 21 Feet; Depth at Sides, 12 Feet

Standard Concrete Barge for Use on the New York State Barge Canal

Authorized Design for Service on State Canal—Unusual Refinement of Concrete Used—Plans and Specifications

PURSUANT to their policy of issuing completed plans to the shipbuilding industry, the Emergency Fleet Corporation has again come forward with drawings and specifications for the construction of a standard concrete canal barge for use on the New York State Barge Canal.

The boat is 150 feet long, 21 feet beam, and 12 feet depth at the sides. It has a load draft of approximately 9½ feet; a displacement, loaded, of 756 tons, and a deadweight carrying capacity of about 489 tons. It is of the open hull type, with cargo hatches 14 feet wide, leaving 3½ feet deck space on each side.

For most of its length the hull is practically square, with a rounded bow and ship-shaped stern. The main frames along the bottom are 6 by 18-inch girders, with square bar reinforcement in upper and lower planes connected by small bar stirrups. At the sides the frames are 6 by 12-inch girders, turned at the deck and extended to the hatch coamings. Every fourth frame is carried across the hatches as a cross brace.

The barge has a center and two side keelsons forming the longitudinal stiffeners, and side frames of normal reinforced concrete girders spaced 5 feet on centers and carrying an outer single shell. Except forward of the forward bulkhead, where the shell is 4½ inches thick, and

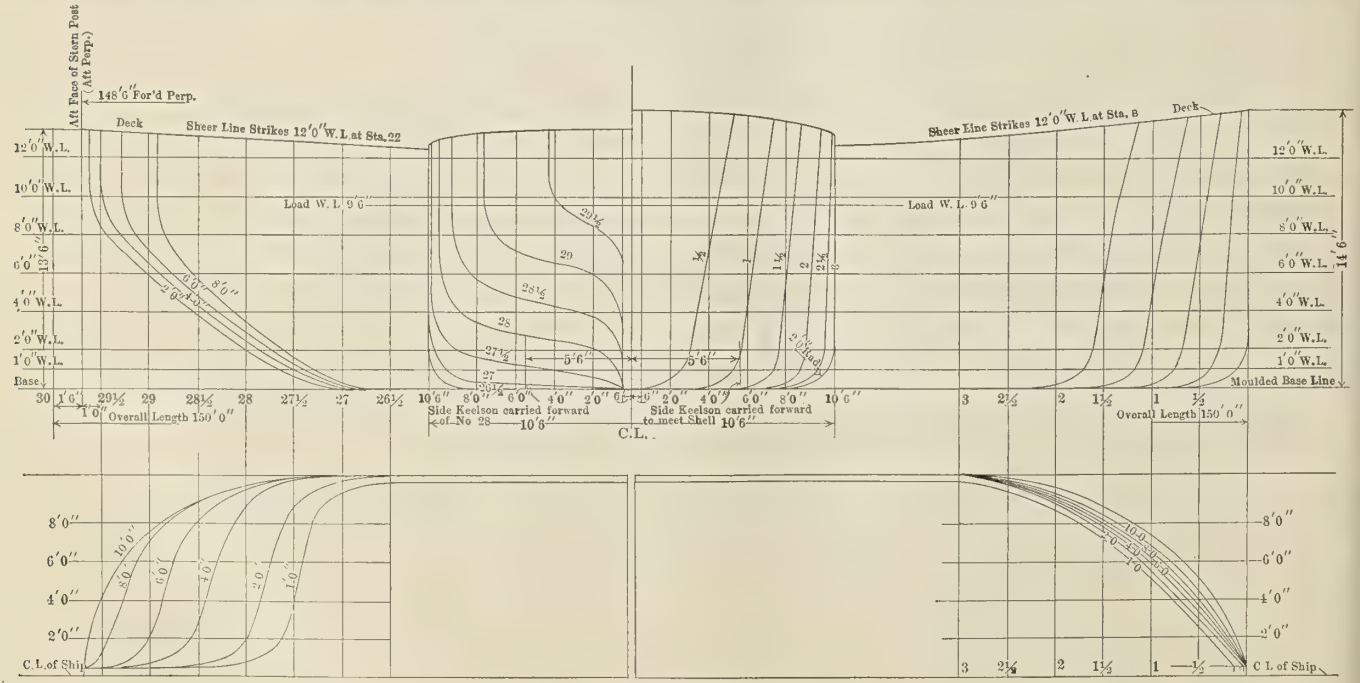


Fig. 2.—Lines of Concrete Canal Barge

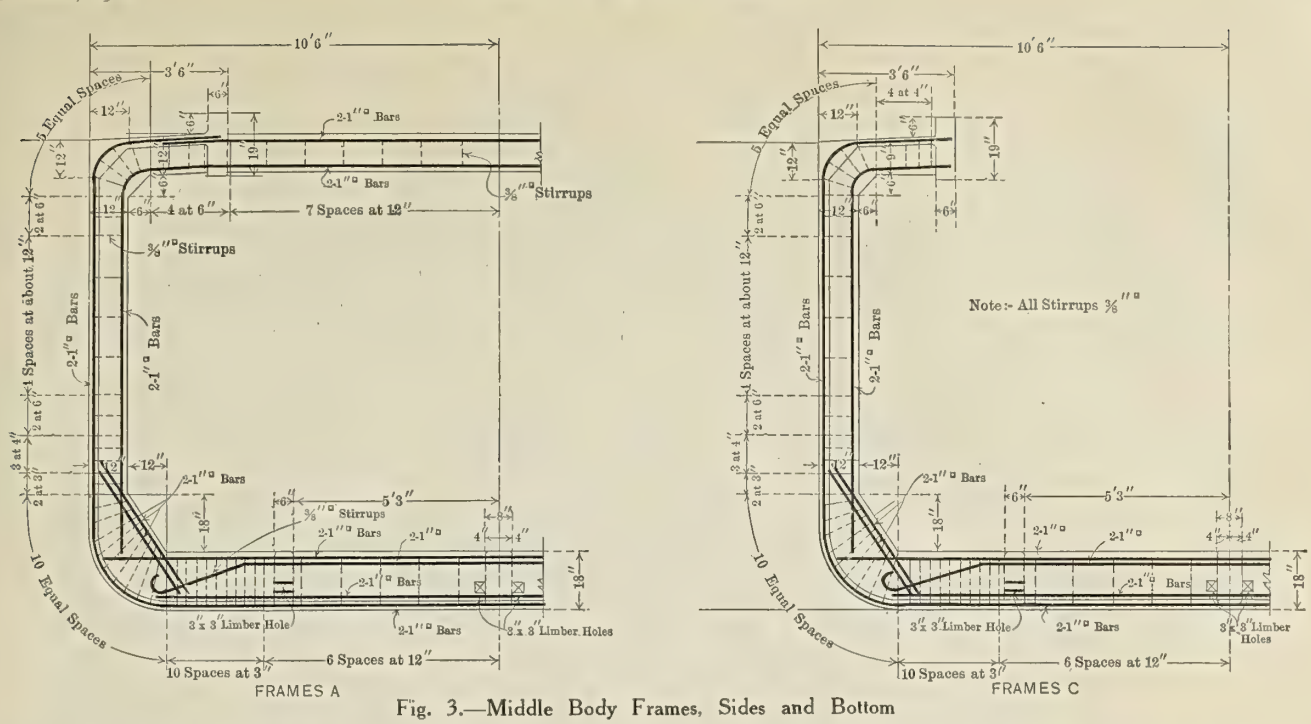


Fig. 3.—Middle Body Frames, Sides and Bottom

aft of frame 26, where it is 4 inches thick, the shell is 3 inches thick, as is also the deck slab. Both the shell and deck slabs are reinforced with ½ and ⅜-inch rods running horizontally and variously spaced, according to the location in the shell or deck. There are also ½-inch vertically running shear rods spaced 7 inches center to center. At the turn between the side and the deck, the shell is further stiffened by a number of longitudinal rods.

All horizontal steel in the sides on the midship section is carried around the bow and stern. The steel in the bottom and bilge is carried forward and aft as far as possible without interfering with the steel from the sides. A transverse bulkhead, consisting of a 3-inch vertical wall bearing against three 7-inch vertical girders which frame into longitudinal deck girders, is provided 15 feet from the bow.

In the hold a wooden floor consisting of 4-inch plank is laid across the frames and extends up the sides to the under sides of the deck. The hatch covers are timber frames which can be lifted off the seat and are made up of 6 by 8-inch yellow pine timbers bolted to the reinforced concrete girder forming the hatch coaming.

Cabin and storage spaces are provided in the bow and stern. The flooring in these spaces consists of ⅞-inch tongued-and-grooved white pine laid upon one layer of ⅞-inch sheathing with one thickness of building paper between. The flooring beams are 2 by 6 inches of yellow pine spaced about 16 inches apart. The siding inside is of yellow pine, ⅞ by 3-inch tongued, grooved and beveled, laid horizontally with molding at under side of windows. The corner posts are of rounded yellow pine. The top of the house is constructed of 2-inch tongued-and-grooved yellow pine planking. The doors are 1½ inches thick, framed, of panel inside and outside, and hung with brass hinges fitted with locks and knobs, staples and buffers.

There is a wooden stairway leading from the deck to the cabin door, and the cabin is provided with a stove stand, properly insulated with ⅜-inch asbestos and sheet metal, and a sink and lockers, shelves and bins.

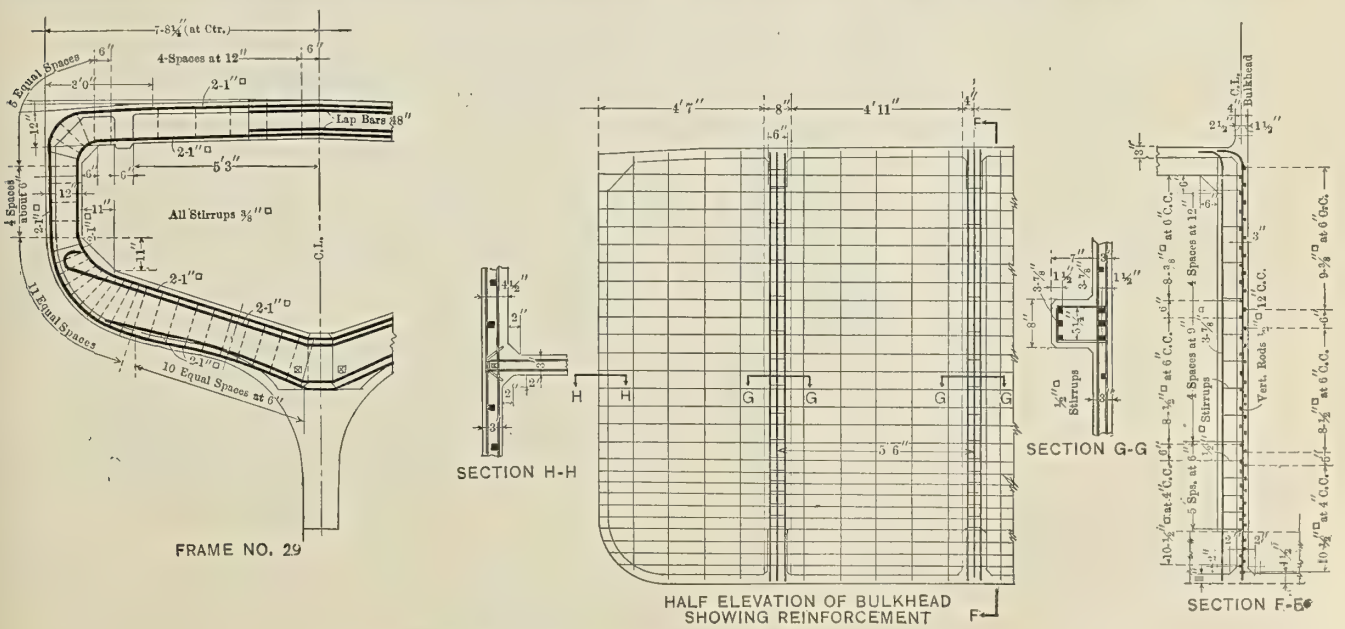


Fig. 4.—Some Sections and a Half Elevation Showing Reinforcement

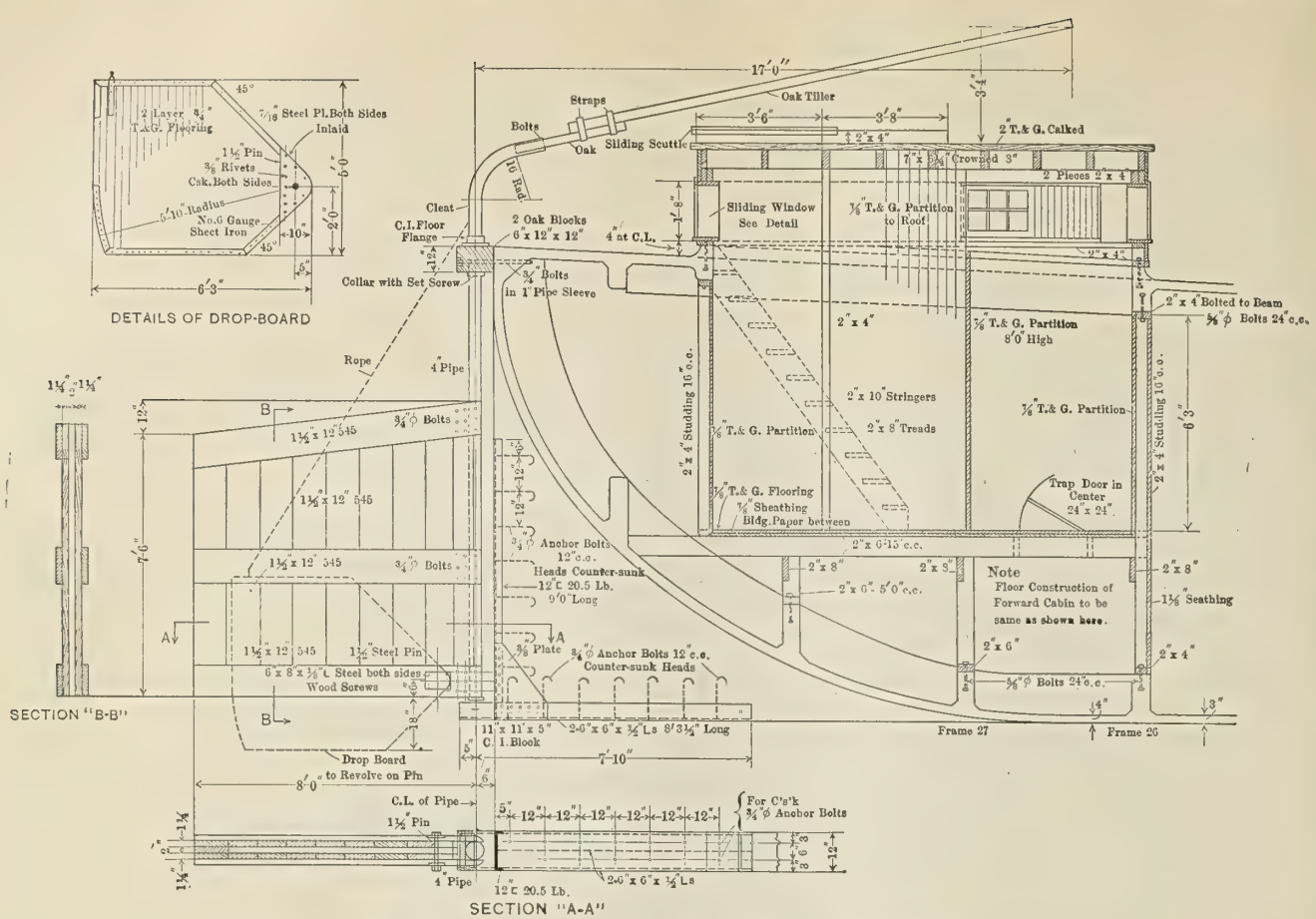


Fig. 5.—Details of Drop Board and Design of Rudder Posts

Spruce, oak and yellow pine enter into the construction throughout, and the concrete used is of somewhat unusual refinement. It is to be ground to such a powder that the residue through a standard 200 sieve shall not exceed 10 percent by weight. This is called for in the hope of getting a high strength concrete with a minimum of delay. Concrete for the slabs—that is, for the deck, bulkhead and shell—is to be mixed in the proportion of one sack of Portland cement, ⅔ cubic foot of fine aggregate, and 1⅓ cubic feet of ¼-inch aggregate. For the frames, a concrete can be used consisting of one sack of Portland cement, one cubic foot of fine aggregate, and 2 cubic feet of ½-inch aggregate. Continuous concreting is to be carried out if possible. In case a joint is found necessary, one only will be allowed, and this on a line 2 feet below the deck of the barge.

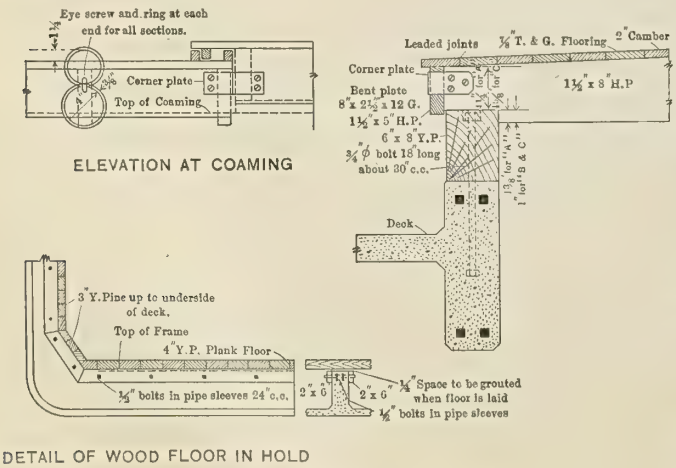


Fig. 6.—Details of Coaming and Wood Floor

Post Commandants Needed for Junior Naval Reserve

The U. S. Junior Naval Reserve, which is doing such splendid work in the training of American boys for sea service, are preparing to organize a State council in every State for the purpose of extending the organization of local posts into every town. Just now they are looking for men who are willing to serve as post commandants. Retired navy or army officers, or draft exempt men with military training, would make good men for post commandants. All applications should be addressed to Mr. Edward A. Oldham, executive secretary, U. S. Junior Naval Reserve, National Headquarters, 218 West 58th street, New York.

A syphon is a mystery to some, as they cannot see how water can run up hill. It does not. It is forced up the short leg of the syphon tube by the weight of the air and then runs down the long length by gravity. There are no mysteries in nature.

"Almost a pound" is all right for one pound but when it comes to a large number of pounds it is another matter. Wood screws are sold by the length and number, the latter referring to the size of wire used in making them.

Large profits are possible on small transactions; small profits generally go with large deals. No one will get poor taking even very small profits; but they must be real profits and not book profits.

Stress Distribution in Bolts and Nuts*

Character and Analysis of Strains in Butt Straps—Instrument for Ascertaining Difference in Thread Pitch

BY C. E. STROMEYER

THIS subject is at present of considerable importance, partly because it is desirable to be able to compare the merits of the coarse and fine screw thread standards, and partly, as will be seen, because modification in the several standards might materially improve them, both as regards strength, reliability, and usefulness. It seems desirable, therefore, to bring this inquiry to the notice of marine engineers, who use bolts for a diversity of objects.

The problem is related to that of riveted joints. In 1885 Mr. J. T. Milton mentioned some experiments (Transactions, Institution of Naval Architects, volume XXVI, page 204) which showed that riveted seams with three rows of rivets were relatively weaker than those having only one or two rows. The subject was discussed in my work on boilers, and recently Professor Batho has measured the strains in the butt strap plates between successive rows of rivets (Franklin Institute, 1916, volume 182, page 553).

Character of the Strains

This problem is a comparatively simple one, especially if, as in Fig. 1, the two butt straps are assumed to be in compression, in the same way as a nut is in compression. These butt straps rest on a platform E, and the central plate is subjected to a pull P_0, which is also the tension stress if the plate section is unity. Starting at the top of the structure there is a force P_1, acting on the rivet A, which produces a deflection and results in a slight relative displacement, $a_1 = z \cdot P_1$, between the inner and outer plates. At B we have the displacement $a_2 = z \cdot P_2$, etc., where z expresses the amount of elasticity or give of the rivet in its three holes. The elongation of the center plate between A and B is $b_1 = e \cdot P_1$, where e is the elasticity of the plates. The contraction of the outer plates is also b_1. Therefore $2 \cdot b_1$ is the excess displacement at B over that at A, and we have generally:

$$a_1 = z P_1; \qquad b_1 = e P_1$$

$$a_2 = a_1 + 2b_1 = z \cdot P_1 + 2 \cdot e P_1 = z \cdot P_2; \qquad b_2 = e (P_1 + P_2)$$

$$a_3 = a_2 + 2b_2 = z \cdot P_2 + 2 \cdot e (P_1 + P_2) = z \cdot P_3; \qquad b_3 = e (P_1 + P_2 + P_3).$$

These expressions can easily be combined and then give:

$$P_2 = P_1 (1 + 2 \cdot e/z)$$

$$P_3 = P_1 (1 + 2 \cdot e/z)^2 + 2 \cdot \frac{e}{z}$$

$$P_4 = P_1 (1 + 2 \cdot e/z)^3 + 2\left(2 \cdot \frac{e}{z}\right)^2 + 6 \cdot \frac{e}{z}$$

The tensions in the center plates are successively P_1; $P_1 + P_2$; $P_1 + P_2 + P_3$; $P_1 + P_2 + P_3 + P_4 = P_0$. When the summation is carried out, the problem is solved in terms of P_0, provided that the ratio of the elasticities e and z are known.

Instead of rivets passing through the plates, we can provide both the center and outside plates with V-shaped projections; these plates can be made of celluloid and stressed while being illuminated by polarized light, which, as has been shown by Professor Coker (Transactions, Institution of Naval Architects, 1911, volume LIII, part 1, page 265), reveals the nature of the stresses. This idea has been beautifully carried out by Mr. Rowland, of the Technical School, Leicester, who has kindly sent me a copy of one of his photographs (Fig. 3). This photograph shows very clearly that certain stresses under the roots of the threads increase quite steadily from the top thread to the bottom one. It does not seem possible as yet to measure the stresses accurately, but, roughly speaking, the shear of each thread section is proportional to the area bounded by the dark bands. These areas increase approximately, as indicated above. If it should be found that the agreement between experiments and the above theory is a fairly close one, then it is very probable that the results of the following investigation, which are based on the same principles, deserve being looked upon as reasonably safe guides with regard to the stress distribution in bolts and nuts.

A screw is, of course, not a series of teeth, but we might make a number of half-sections of plates of the pattern in Fig. 2, place them side by side, but slightly

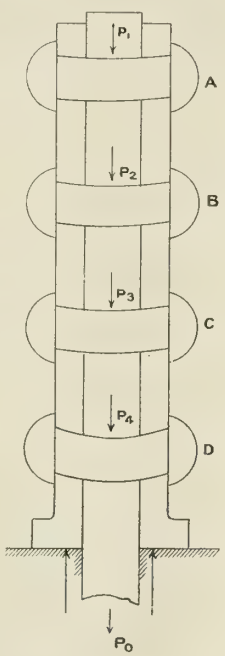


Fig. 1.—Butt Straps

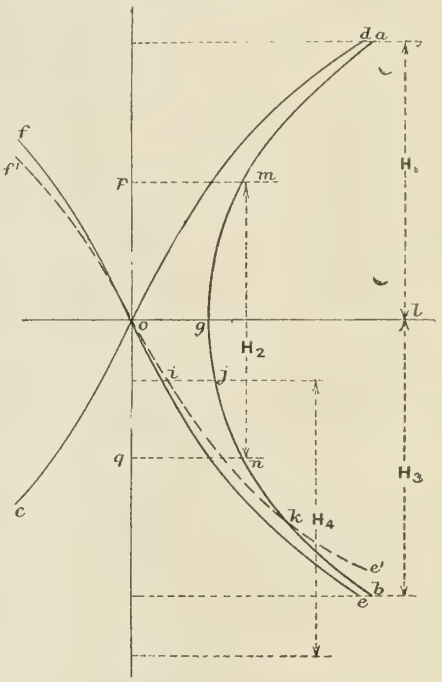


Fig. 2.—Stress Results

staggered, combine the lot and bend the combination till the two ends meet; then we have a bolt and nut in which the steps can, by subdivision, be reduced to smooth threads.

As might be expected, the mathematical treatment of this problem led to an exponential curve of the form $a \pm bx.$, which is what would be obtained in the butt strap problem, if the successive rivets were infinitely close together, in which case the terms outside the brackets would disappear. But it was felt that the possibility, or rather the certainty, that the thread pitches of the bolt and nut

* From a paper read at the spring meetings of the fifty-ninth session of the Institution of Naval Architects, London, March 21, 1918.

would not always be exactly the same should be taken into account. This has been done, and the result is most interesting, as will be seen from Fig. 2, which represents the shearing stress distribution over the height of the nut. For the case in which the pitches of the two threads are exactly equal, the stresses are represented by the horizontal distances between the curves *o d* and *g a*, the height of the nut being *H*. It will be seen that the stress at the bottom of the nut *o g* is very much greater than at the top *a d*.

Stress Distribution in Nuts

Assume now that the nut is being elongated slowly, due, for instance, to its being warmed, the bolt remaining cold, then in Fig. 2 the line *c o d* will slowly swing round against the clock and also straighten itself out, while the nut, whose original position was *H*, will slowly move downwards. The *b g a* curve remains stationary. When the expansion, and therefore the excess pitch, $1/n$ amounts to exactly the ratio of the tension stress in the bottom of the bolt to the modulus of elasticity, then the *c o d* curve will be the straight line *q o p*; the position of the nut will now be H_2, and the stress distribution will be represented by the horizontal distances between *q o p* and *n g m*. It will be seen that the stress distribution is now a fairly even one, the stresses at the top and bottom of the nut being equal. The condition, however, is not the most favorable one, because these shearing stresses combine with the tension stress in the bolt, and there would still be a relatively severe resultant stress at the bottom level of the nut, the very point where the stresses should be reduced to a minimum.

Allowing the expansion of the nut to continue till the excess pitch is twice as much as in the last case, then the *c o d* curve will have swung round to the position *e o f*, and the nut will have sunk to the level H_3. The stress distribution is now exactly the same as in the first case, except that the maximum stress is at the top level of the nut, where, if a fracture should occur, the harm done would not be serious.

If the difference of pitch be increased still further, or if it be reduced to less than in the first case, i. e., if the nut had originally had a finer pitch than the bolt then the stress distribution would be a triangular one, as indicated by the outline *i j k*. Beyond *K*, down to the bottom of the nut H_4, the threads would not be in contact. The stress *i j* would therefore be very severe. If the nut has a finer thread pitch than the bolt, this very severe stress would be situated at the bottom level of the nut, and would cause cracks, fractures, or stripping of threads.

Failure 1.—This conclusion was confirmed by the failure of several successive piston rods of some large horizontal gas engines. The rods were 12 inches diameter and hollow. The screwed part was 11 inches diameter, pitch four threads per inch. Several of these rods had broken just inside the nut, others stripped their threads. Of these, unfortunately, only one was seen; its nut thread pitch was 1/1000 finer than that of the rod. The gas pressure and the inertia stresses in the rod were estimated to be about 2½ tons, but according to my present estimate the maximum stresses under the roots of the threads would be about ten times greater, or about 25 tons per square inch. No wonder that the threads gave way!

Failure 2.—Some main bearing bolts had failed frequently almost as soon as they were renewed. They were not subjected to excessive loads, and the metal—steel—was found to be quite satisfactory. Subsequently, in view of the above-mentioned experience, the threads of one fractured bolt and its nut were compared, when it was found that the nut thread, a fairly coarse one, was 4/1000 finer than the bolt thread pitch. In this case my estimate was that the stresses under the roots of the threads exceeded 30 tons.

In case of future failures, it would be very desirable to ascertain whether there is a difference of thread pitch. This can easily be done with the help of the simple instrument shown in Fig. 4. Two bars, *B* and B_2, are placed one on top of the other. Two U-frames, U_1 and U_2, are attached to B_2. The one has an ordinary set screw, C_1, the other has an elastic one, C_2, shown in section with its enclosed spring. A dial *D* is attached to U_2 and two pins, P_1 and P_2, are screwed into the ends of the bars B_1 and B_2. These pins are pressed into the screw threads of the nut

Fig. 3.—Photograph Showing Stress at Root of Threads

N. C_1 is now screwed down lightly and the instrument is removed. At the *D* end, B_1 and B_2 are separated slightly and a fine rolling pin *R* (steel wire of about 0.01 or 0.02 inches diameter) is inserted. Its pointer traverses the dial *D*. The instrument is now replaced, C_2 is screwed down, and C_1 slacked back, while the pins p_1 and p_2 are pressed into the threads. A reading is then taken on the dial *D*. The instrument is then transferred to the bolt, C_1 being temporarily tightened, and another reading is taken. The difference of the readings divided by the distance p_1, p_2 is the difference of the two pitches. These readings can easily be taken to ten-thousandths of an inch. Such an instrument can easily be made by any mechanic, and would be found useful for many purposes.

It would take too long to discuss the results of this investigation as fully as the subject deserves. Therefore, only a very brief reference will be made to certain of the final results. It should, however, be borne in mind that these numerical values have only a comparative value until they have been confirmed by experiments like those which Mr. Rowland is now carrying out. For ordinary practice, in which the pitches and the thread shapes are

supposed to be alike, coarse bolts similar to the Whitworth practice for 1-inch bolts are associated with lower stresses than the Seller bolts of the same proportions, the ratio of the estimated stresses being as 3.08 to 4.07. A change to medium fine pitches hardly reduces the stresses, and very fine ones (32 per core diameter) actually increase them, although the stress in the body of the bolt is reduced from 1.56 to 1.13 by the adoption of the finer pitch.

If by chance the nut thread pitch is finer than that of the bolt, then the Whitworth bolts improve their position still more. If they are coarser than the bolt threads, the improvement is shared by all screws. This improvement is very marked except with the very fine threads, which hardly improve. In all these cases the maximum stress is transferred from the bottom of the nut, where it is dangerous, to the top, where even if a thread should strip there are others to take its place. By this change the above-mentioned stress of 3.08 at the bottom of a Whitworth bolt is reduced to 1.74, while the stress at the top does not rise above 2.16. For very fine threads the relative stresses are 3.34 for equal pitches and 1.15 and 2.73 for the unequal ones. For Seller's threads they are 4.07, 1.76 and 3.21.

Another point in favor of relatively coarser pitch of nut thread than bolt thread is associated with the tendency to slack back. With equal pitches for bolt and nut the maximum pressure will be at the bottom of the nut, and will probably produce a kink in the thread of the bolt at the bottom of the nut, which kink, if vibrations occur, will hammer against the bottom nut thread and start a slacking back process. If the nut thread be made coarser than the bolt thread the kink will be at the top, and, instead of starting a slacking back process, it opposes it even if started.

As regards thread angles, fine ones like the B.A. shape, especially if the pitch is a coarse one, have the advantage that their elasticity leads to a relatively uniform stress distribution over the height of the nut. The advantage of heavy truncations, as in the Thury standard, in which the roots of the threads are very wide, is that the very intense stresses under these roots are spread out over a relatively large area and are thereby reduced.

A seriously disturbing factor is the difficulty on the part of manufacturers to make the thread shapes perfectly correct. For instance, taking a 1-inch Whitworth bolt, the flat parts of the threads measure about 1/16 inch, and an error of even 1 degree in the slope angle affects the dimensions by only 1 ÷ 1,000 inch, which can hardly be detected, and when chasers, taps and dies wear out, the angles undergo even larger changes. It is therefore a common occurrence for the nut thread to have either a finer form than that of the bolt in which its crest will be resting close to the root of the bolt thread, which is a very favorable condition, or it may happen that the nut thread is of a relatively blunt form; possibly, too, it may by accident be tilted upwards—worn-out nut—then its root will bear on the crest of the bolt thread and the stresses will be two and three times severer than in the last case.

As these misfits are of constant occurence—even the large-scale celluloid model, Fig. 3, was not perfect—engineers have to provide against these worst cases by using relatively large bolts. A great improvement should be possible by using the Seller slope of 30 degrees for the bolt thread, and the Whitworth slope of 27½ degrees for the nut thread, for then the errors would have to exceed 1¼ degrees before improper loading occurs.

Being limited for space, this paper had to be made as short as possible. This explains why many interesting side issues have had to be avoided, and why several suggestive modifications which have been made could not be discussed in detail. It is hoped that despite the difficulties under which the paper has been written some of its indications will prove to be of immediate advantage to designers of marine engine parts.

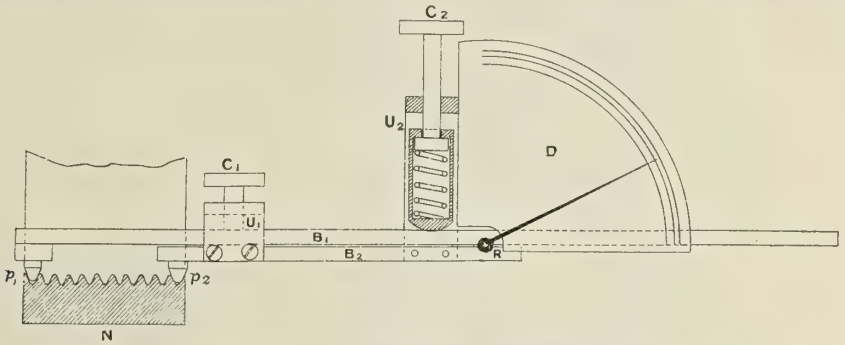


Fig. 4.—Instrument for Ascertaining Difference in Thread Pitch

Among these indications there is one to which no direct reference has been made in the body of the paper, not because it is unimportant but because to mention it would have withdrawn attention from the elementary principles to which it was intended to confine the paper. This subject may be briefly indicated by the following remarks. Every practical engineer knows that mild steel is a very reliable material. It is exceptionally plastic, and when subjected to complicated severe stresses, more particularly if they are confined to microscopically minute localities, it will take minute local sets, which effectively ease the situation by equalizing stresses. If, however, we wish to employ high tenacity steel, and the tendency in that direction is both strong and justifiable, at least for small bolts, severe stresses, no matter how concentrated they may be, will produce minute cracks or will at least produce local brittleness. If these cracks or deteriorations occur near the bottom levels of nuts, they are unquestionably extremely dangerous. If, therefore, high tenacity steel is to come into more general use for bolts, these severe stresses must be reduced or they must be shifted to the top levels of the nuts. One very effective move in the direction of equalizing stresses has already forced itself on engineers who have found that mild steel nuts must be used with high tenacity steel bolts, the explanation being that their threads take permanent sets at stresses which are lower than those which would produce cracks in the roots of high tenacity steel bolts. Other promising alternatives do not seem to have been tried.

A drop of oil will often prevent a squeak but it may take a gallon to stop its squeaking.

Investigation of the Shearing Force and Bending Moment Acting on the Structure of a Ship, Including Dynamic Effects*

BY A. M. ROBB, B. SC.

THE proposed vessel treated in this investigation is of the intermediate, cargo-and-passenger type, having the following general particulars:

Length between perpendiculars, 340 feet; breadth, molded, 50 feet; depth, molded, 29 feet; draft load, 19 feet; displacement at load draft, 6,200 tons; block coefficient, .67.

Two conditions of loading having been considered, the "standard hogging" and the "standard sagging" conditions. The particulars of these are given below:

	Standard Hogging	Standard Sagging
Hull and machinery	3,200	3,200
Cargo forward	1,065	1,065
Cargo aft	705	705
Fuel	.....	620
Fresh water amidships	.....	261
Fresh water aft	56	.....
Stores amidships	.....	55
Stores aft	10	.....
Baggage and mails	.....	30
Passengers	15	15
Water ballast forward	72	.....
Total tons	5,120	5,950

Statical Calculations

In the first place the ordinary hogging and sagging shearing force and bending moment curves were drawn. It was then decided to trace the variation of shearing force and bending moment as the ship traversed the waves, assuming her to be in statical equilibrium in each successive position. Accordingly, five further positions of the ship on the wave were taken, each being one-sixth wave length in advance of the preceding one. The successive positions of the ship on the wave are shown at the top of Figs. 1 and 2. The weight curves are also shown, and below the weight curves the series of buoyancy curves; each buoyancy curve is numbered to correspond with the position of the ship indicated above. The shearing force and bending moment curves, shown below the buoyancy curves, are also numbered to correspond with the positions of the ship indicated above.

It is interesting to note that the "standard" curves, marked "1" in each case, practically envelop all the other curves. Actually, the "standard" positions on the wave give at the extreme ends slightly smaller bending moments than some of the other positions; but the differences are so small, except in one case shown in Fig. 2, that they cannot be clearly shown on the diagrams. It is worth noting also that the "standard hogging" curve shown in Fig. 1 completely envelops the hogging curves obtained for the "standard sagging" condition of loading, shown in Fig. 2.

These results indicate that the "standard hogging" and "standard sagging" bending moment curves give, as well as the maximum values amidships, the maximum statical bending moments at all points along the length, unless at

* From a paper read at the spring meetings of the fifty-ninth session of the Institution of Naval Architects, London, March 22, 1918.

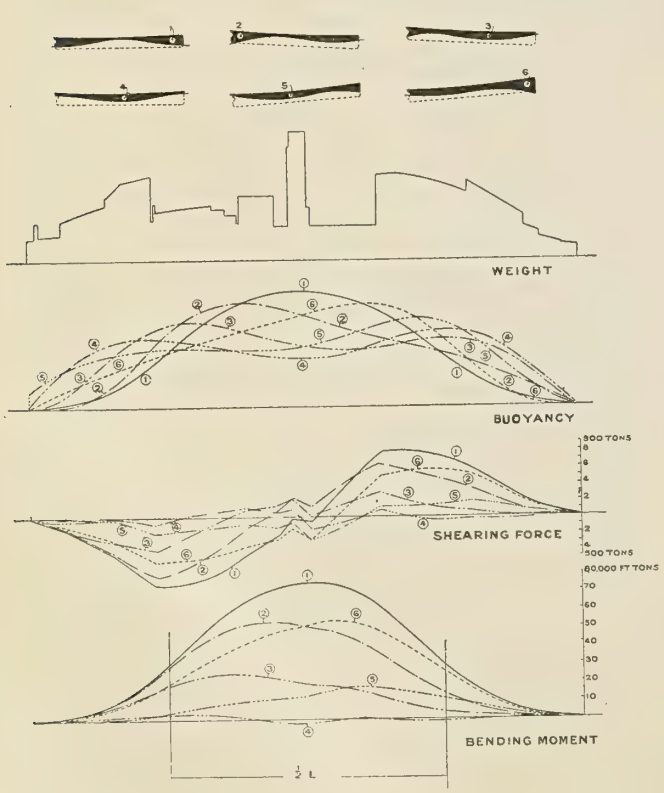


Fig. 1

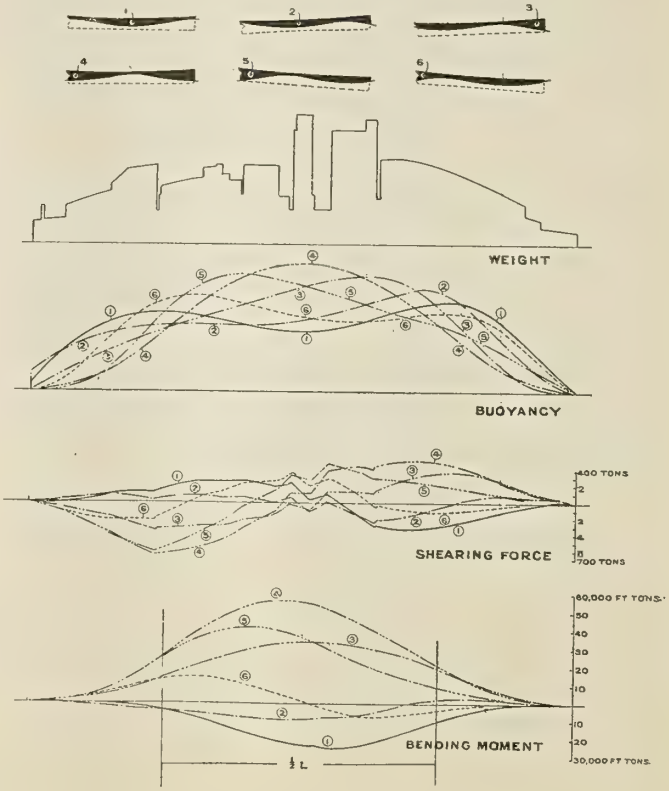


Fig. 2

the extreme ends, where, of course, the value of the bending moment is not of importance.

The Effect of Heaving

In the part of the investigation falling under the above heading, it is assumed that heaving motion can exist independently of pitching motion; in other words, it is assumed that a vessel can traverse a series of waves in such a manner that, while the displacement is continually varying, the centers of gravity and buoyancy are always in the same vertical line. The mathematical analysis of such a motion is given in an appendix. It is here necessary to consider the effect of the motion on the matter comprising the ship and her load.

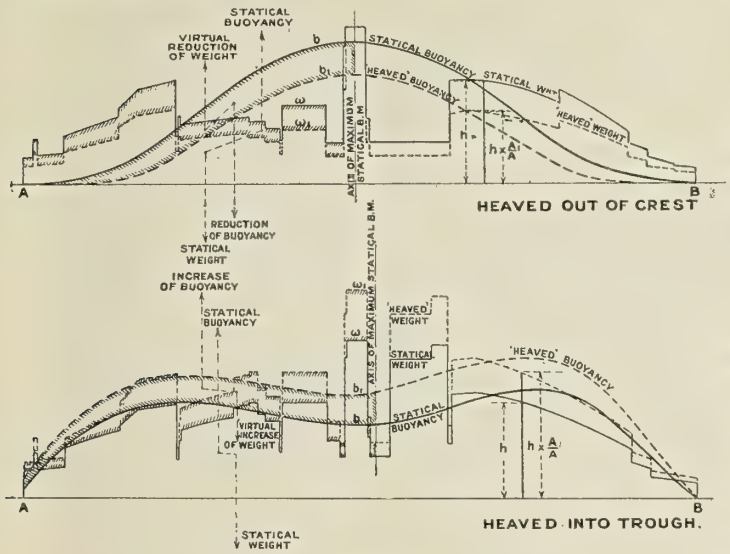


Fig 3

When a ship is heaving, the effect of the alternate upward and downward acceleration is that the "weight" is continually varying. When the acceleration is upwards, the "weight" is greater than, and when the acceleration is downwards the "weight" is less than, the normal amount when in statical equilibrium. For convenience, the "weight," when under the influence of heaving motion, is distinguished throughout as the "virtual weight." The upward acceleration, and so the "virtual weight," has a maximum value when the vessel is at her lowest position, heaved into a wave; the "virtual weight" is, then,

$$W + \frac{W}{g} \cdot \frac{d^2 y}{d t^2}, \text{ where } \frac{d^2 y}{d t^2}$$

is the amount of the maximum vertical acceleration. The corresponding buoyancy is $\Delta + P$, where P is the maximum excess buoyancy due to heave. Similarly, for the vessel heaved out of a wave,

$$\Delta - P = W - \frac{W}{g} \cdot \frac{d^2 y}{d t^2}.$$

The excess, or defect, of buoyancy is always equal to the excess, or defect, of "virtual weight" in relation to normal weight.

It follows that if the "heaved" buoyancy of a vessel is known, the corresponding "virtual weight" is known.

Since the "virtual weight" of a vessel when heaving is expressed by

$$W \pm \frac{W}{g} \cdot \frac{d^2 y}{d t^2},$$

the "virtual weight" of every element of the vessel is, likewise, expressed by

$$w \pm \frac{w}{g} \cdot \frac{d^2 y}{d t^2}.$$

The acceleration

$$\frac{d^2 y}{d t^2}$$

is the same for every element as for the complete vessel. Accordingly, the "virtual" correction at any point along the ship,

$$\frac{w}{g} \cdot \frac{d^2 y}{d t^2},$$

is proportional to the product of the element of weight and a constant quantity, the constant quantity being

$$\frac{w}{g} \cdot \frac{d^2 y}{d t^2}.$$

Hence it is possible to obtain a "virtual weight" curve by altering all the ordinates of a normal weight curve in a constant proportion. The extent of the alteration is governed by the condition that

$$\pm P = \pm \frac{W}{g} \cdot \frac{d^2 y}{d t^2};$$

in other words, the extent of the alteration is governed by the condition that the area under the "virtual weight" curve must be equal to the area under the "heaved" buoyancy curve. And so, having determined a "heaved" buoyancy curve, the corresponding "virtual weight" curve is obtained by proportioning the ordinates of the normal weight curve, so that the amended area, the area under the "virtual weight" curve, shall be equal to the area under the "heaved" buoyancy curve. For example, referring to Fig. 3, the area under the "heaved" buoyancy curve $A\ b,\ B$ is A_1; the area under the normal, or statical, weight curve $A\ w\ b$ is A. Each ordinate, such as h, of the statical weight curve is altered in the proportion

$$\frac{A_1}{A}, \text{ becoming } h \times \frac{A_1}{A}.$$

The area under the "virtual weight" curve $A\ w_1\ b$ so obtained is, then,

$$A \times \frac{A_1}{A}, \text{ or } A_1.$$

From the "virtual weight" and "heaved" buoyancy curves the "heaved" shearing force and bending moment curves are obtained by integration in the ordinary manner.

As regards extent of heaving motion, it was shown by Mr. T. C. Read that for a vessel on the crest of a wave the only possible heave of any magnitude is a heave *out* of the wave; for a vessel across the trough of a wave the only possible heave of any magnitude is a heave *into* the wave. As regards the effect on the bending moment, the effect of the heave with the consequent alteration of buoyancy and "virtual weight" is that an additional bending couple is brought into action; when the vessel is heaved out of a wave the buoyancy and "virtual weight" are less than normal, and the additional bending couple acts in opposition to the statical couple, so that the bending moment, including heaving effect, is less than the statical moment; when the vessel is heaved into a wave and the buoyancy and "virtual weight" are greater than normal, the additional bending couple acts in conjunction with the statical couple, so that the bending moment, including heaving effect, is greater than the statical moment (see Fig. 3).

(*To be continued.*)

Electric Propelling Machinery for the Battleship Tennessee

WHILE electric propulsion gives approximately the same overall economy in steam consumption as a geared turbine drive, nevertheless it offers an added advantage of greater latitude in the location of the propelling machinery, a feature which is of greatest importance in the design of naval vessels. The United States Navy has taken the lead in the application of electric drive to battleships and battle cruisers; and of the recent installations, that of the battleship *Tennessee* is of special interest, as it involves certain features which have been developed as a result of previous installations of electric propelling machinery in vessels of this class. The principal details of the installation on the *Tennessee* were described by Wilfred Sykes, general engineer for the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., in a recent issue of *The Electric Journal,* from which the following information is taken:

The *Tennessee* will be one of the most powerful fighting ships built, having displacement of over 32,000 tons and a speed of 21 knots at full power. The equipment for propelling the ship will consist of four 3-phase induction motors, each driving one propeller, and two turbo generators for supplying the motors with power.

Each of the four motors will develop 7,000 horsepower at a speed of about 180 revolutions per minute, and will be capable of working continuously at 8,375 horsepower as an overload condition. The motors have two windings of 24 and 36 poles, so that they have two normal speeds of 123 and 180 revolutions per minute with full speed of the turbine. In this way it is possible to run the turbine at its most economical speed when steaming either at full power or cruising at 15 knots. Intermediate speeds are obtained by varying the speed of the turbine, and the equipment is designed to maintain a low water rate over the full range of speed from ten knots up. When operating below 17 knots, only one generator is used, and this improves the economy, as the load on the unit is brought nearer to its full capacity.

Two-Pole Generators

The turbo generators supplying power to the main units each develop 13,500 k. v. a. at full speed and are capable of carrying 15,000 k. v. a. continuously for the overload conditions. The generators are two-pole machines and the unit runs at 2,190 revolutions, corresponding to 36.5 cycles per second, with the motors running at 180 revolutions per minute. The maximum speed of the turbo generator is 2,270 revolutions per minute, corresponding to 37.9 cycles, equivalent to a motor speed of 186.5 revolutions per minute, which requires 8,375 horsepower. To obtain lower speeds, the turbine speed is reduced to about 1,500 revolutions per minute, which corresponds to the change-over point from the 24- to 36-pole connection of the motors.

With the change-over of the motor connections, the speed of the generator is increased to 2,270 revolutions, corresponding to 15 knots with the 36-pole connection. The motor speed combination is simply the equivalent of a variable ratio of gearing, which, in the case of the 24-pole connection, is 12:1, and with the 36-pole connection 18:1.

The direction of rotation of the machines is controlled by reversing switches which simply transpose two of the phases at the motors, the generator, of course, continuing to run in the same direction.

The motors have two separate windings on the stator, one the 24-pole and the other the 36-pole connection. The same results might have been obtained by use of one winding, but this would have entailed greater complication in the connections and would have restricted the design in other ways.

The rotor has a single polar winding for 24 poles, which is connected to the slip rings in the ordinary way, so that resistance can be inserted in the circuit during starting or reversing. When the machine is operating on the 36-pole connection the rotor winding cross-connections act as short-circuiting connections for this pole combination. With the 24-pole combination, they act as equalizing connections between points of equal potential. On the 36-pole connection the motor operates as a squirrel cage machine, and it is not intended that this winding should be used during the starting or reversing, but only as a running winding. In this way only one winding is used and one set of slip rings.

The Turbine Governor

The speed of the turbine is varied by means of a unique hydraulically operated governor. The loading of the governor is regulated by means of a variable pressure oil system, the pressure of which is regulated with great accuracy by a pressure regulating mechanism operated by the control handle. In this way any mechanical connection through shafts or rods with the governor from the operating point, with the consequent danger of jamming where passing bulkheads, is avoided. A unique feature of this arrangement is that the pressure is caused to pulsate slightly so that the whole of the regulating and governor mechanism is kept slightly in motion, and thereby prevented from sticking, also adding greatly to the sensitiveness of the control, which is of great importance when ships are steaming in formation.

The turbines are of the Westinghouse semi-double flow, impulse-reaction type. The high pressure steam is expanded in suitable nozzles and passes through a two row impulse wheel, after which it passes through the first stage of the reaction expansion, which is single flow. The steam then divides and passes through the low pressure stages of the turbine, which are double flow. The turbine is provided with an automatic stop to cut off steam in case the speed should exceed the maximum safe operating value. The main hydraulically operated governor maintains speed practically constant at any value set by the control mechanism, independent of the load, so that in case the propellers should leave the water during rough weather there will be no racing.

Insulation

The generators and motors are very carefully insulated for this service, so as to prevent damage due to moisture or the accumulation of salt, and also due to the high temperatures which are liable to be encountered in this service. The principal material used for insulation of coils in the slots is mica, and the machines are capable of withstanding slot temperatures up to at least 150 degrees C. without injury. Ventilation of the generators is provided by fans supplying air to each engine room and the fans on the generator forcing the air through the machine and out through ducts. The motors each have two fans mounted directly above them which draw the air through the motor and force it out through the ventilating ducts. The generators are excited from the direct-current power circuit of the ship through boosters which are capable of raising the normal 240-volt supply to 320 volts or reducing it to zero.

The power supply from the turbo generators is brought to a centrally located control room in which is mounted all the necessary switching apparatus for controlling and distributing the power to the motors. In this room is mounted the regulating apparatus for the main turbines, the field switch and rheostat for the turbo generator excitation, and the liquid rheostats for the main motors. All necessary instruments for the operation of the equipment are mounted directly in front of the operators and full advantage is taken of the great facility with which electric power can be measured, inasmuch as it will assist in the operation of the ship.

Automatic Liquid Rheostats

For starting and reversing the main motors, automatic liquid rheostats are used which are of a similar design to those used previously for industrial purposes. These liquid rheostats consist of two tanks, the upper containing a series of fixed electrodes and the lower acting as a reservoir. By means of a suitable pump, the electrolyte is caused to flow from the lower to the upper tank at the proper rate to cause the desired acceleration. When the by-pass between the two tanks is open the electrolyte is maintained within the electrode tank at the proper level to give the maximum resistance. When this by-pass is closed the electrolyte rises in the upper tank, thereby progressively short-circuiting the electrodes until the minimum resistance is reached at the overflow point, after which the liquid simply continues to circulate through the two tanks. A switch is provided so that this rheostat may be short-circuited.

The cables for connecting the turbo generators and motors are of great importance, as the operation of the ship depends upon their reliability. A number of parallel circuits are used, each cable being of the three-core type, and the failure of any single cable would not seriously interfere with the operation of the ship. The main cables are of the same order of importance as the main steam pipes; hence the greatest care has been taken to insure that these cables should be the best type that is possible to manufacture for the service, and to this end a committee of the American Institute of Electrical Engineers assisted the Navy Department in preparing the specifications.

Engine Room Auxiliaries

The main auxiliaries in the engine room are electrically driven. The main circulating pumps are driven by 235-horsepower, direct-current motors, directly connected to centrifugal pumps, the speed of which can be varied to suit various conditions of operation. In this way the power consumption can be reduced as the speed of the ship is reduced. The principal provision for maintaining vacuum in the condenser is the use of LeBlanc air ejectors, which are novel for this class of ship. These air ejectors have already been successfully tried out by the Navy Department on other vessels with such satisfactory results as to justify their adoption for these vessels. The condensate from the condensers is handled by vertical electrically driven centrifugal condensate pumps, so that the whole of the essential auxiliary apparatus for the turbines is rotary, and, based on the experience in land service as well as at sea, a greater reliability and lower maintenance can be anticipated for these equipments compared with past practice. The use of air ejectors enables the vacuum to be maintained at least as high, if not higher, than the older combination of reciprocating air pump and Parsons augmentor, and the space and weight are a very small fraction of that required with the older system.

While steam consumption is not of vital importance, on account of the other advantages of electric drive, yet the figures that can be obtained are very appreciably better than the direct-connected turbine and are lower than any past practice. From 10 to 15 knots, only one generator is used, the motors being connected for 36 poles. From 15 to 17 knots, the motors are connected for 24 poles and one generator is used. From 17 knots to 21 knots, both generators are in operation, each machine supplying power to two motors, each side of the ship being independently operated.

In designing the equipment for the *Tennessee,* every effort has been made to avoid the introduction of experimental or risky constructions, and the design is such that the experience gained in other fields has been utilized to full advantage, and the design factors have been kept within well-developed practice. At the same time, provisions have been made so that the full advantages of the characteristics of electric drive can be utilized in the operation of the ship.

What Italy Is Doing With a Big Inland Waterway Plan

AMONG the progressive things that Italy has been doing in the past dozen years in line with an advance of industry is the beginning that was made upon a system of barge canals in Lombardy, which will eventually give navigation for 600-ton vessels for fully 300 miles into the interior from the Adriatic and tap even the lake region of Southeastern Switzerland.

With about 25 miles already finished, the map calls for 250 miles of "naviglio" along the Po and Adda rivers, with a cut across to Milan some 30 miles long. According to an account of this enterprise given in a recent issue of *The Americas,* it is not only a heavy barge trunk line that is projected, but many spurs will lead off on either side to bring into the waterway system the slow traffic transportation of about a dozen cities of Lombardy that lie between Milan and Venice.

The harbor of Venice has already had attention as part of the scheme, so that the barge traffic will there connect with ships. Further inland, smaller canals extend the benefit of the new transportation to Lake Como and to Lake Maggiore. The ultimate development contemplates a system of inland waterways focusing upon the Lagoon of Venice, with an aggregate length of about 2,000 miles.

It is a government enterprise, to be carried on and financed in co-operation with the various cities that will be benefited, the government bearing three-fifths of the cost, the localities the remaining two-fifths. A new industrial port, with modern harbor improvements, will be developed at Venice. When the full plan of canalization is completed the Po will be navigable by vessels of 600 tons up to Cremona. After canalization of the Adda, which flows down from the Milan country into the Po, near Cremona, the main canal will be dug across the dry land to Milan.

The purpose of the new waterway system is to make possible the inexpensive movement of heavy raw materials needed by local industries, and thus divide traffic with the rails. The rails at this time being badly overworked, such a division would greatly enhance shipping facilities. An important feature of the system will be the up-to-date river terminals established at the inland centers.

Can anyone tell why small spring wire deteriorates in sunlight and becomes brittle?

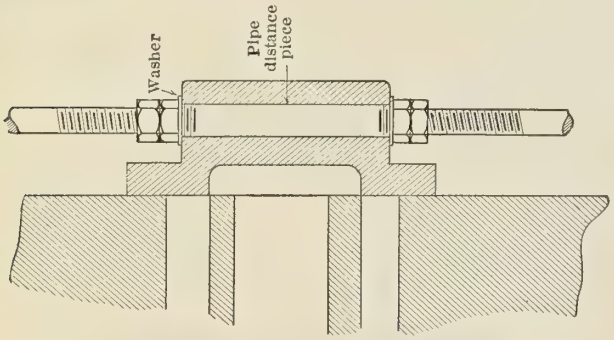
Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Curious Displacement of Slide Valve

A very curious incident occurred to the writer about three years ago. He was on one of the company's tug boats, which had a two-crank, quadruple engine, with the cylinders arranged as follows: High pressure and first intermediate pressure cylinders on stanchions 2 feet above the second intermediate and low pressure cylinders. The high pressure was over the second intermediate and the first intermediate over the low pressure cylinder. While under way, the engine gradually began to slow down, until finally it began to make revolutions with jerks, going very slowly. Luckily, a few minutes' steaming put us in a safe anchorage.



Sketch Showing Valve and Spindle

At first an examination revealed nothing unusual. The second intermediate pressure slide valve was tried and appeared all right, the nuts at top and bottom being perfectly tight. At length we put the second intermediate pressure crank on the top center and discovered the trouble—the lead on top was 1¼ inches. The valve had two nuts on top on the spindle and two nuts underneath on the spindle, yet these nuts were jammed perfectly tight and the valve had only breathing space to keep it on the face. If the valve had dropped as much as it showed by the lead, why was it that all the nuts and the valve seemed all right? Nothing was slack and the thread on the spindle was not stripped.

On slacking off the two top nuts to enable us to raise the valve to the required lead we discovered a pipe distance piece on the spindle. This, of course, passed through the spindle hole in the back of the valve. With the top nut underneath the valve and the bottom nut on top of the valve, both tightened on this pipe distance piece, and the other two nuts acting as jam nuts and the whole tightened up, just left breathing space for the valve to seat, and did not jam the valve. Therefore, it will be seen that the nuts and pipe were practically one long nut and had gradually screwed down the rod. The nuts, when separated, were slack on the rod, and the mere fact of checking the nuts had not arrested the slackness.

Engineers will agree that a pipe distance piece is not a desirable thing to have through a slide valve, unless the valve sits on a collar on the rod, with only two nuts on top of the valve to check it.

Victoria, B. C. EDMUND B. DELL.

Packing Troubles*

In talking to a chief engineer not long ago, I showed him a picture of a metallic packing which is giving very good service all over the United States and Canada. A point in its favor is that it needn't be removed very often, if at all. An installation was inspected lately where a plunger equipped with this packing had been in operation for six years, operating against 160 pounds of pressure, 212 degrees water, operating 12 hours per day. The plunger was not so much as worn 1/1000 inch. The packing was still in perfect condition and looked as though it would last twelve years more. The engineer in charge thought that the packing had saved him considerable time and labor, and the owner considerable money.

The chief engineer to whom I was talking, however, had his mind already made up. He was not open to conviction. He said, "I have tried metallic packing and will never try it again. In time it becomes a solid metallic mass, and, if used in places that are accessible with difficulty, it cannot be removed easily enough. I have had to chip it out in several instances."

It is regretable that such chiefs still exist. He is in charge of a large plant, and his mind should be open to new things. Improvements or attempts at improvements should be looked upon in an unbiased way, regardless of what experience may have taught with other equipment made of the same material. If all engineers had thrown up their hands after the first failure, we would not have progressed very far in the manufacturing world. With any packing, whether it be fabric or metallic, there are some cases where inaccessibility in design of stuffing boxes makes the packing very hard to remove. And the engineer's statement with reference to the metallic packing is true to the extent that it is more difficult to remove than the fabric, though it is the claim of this manufacturer that his packing needn't be removed. In other words, if you get the right packing you can leave it in, and removal troubles are eliminated. In case it is necessary to remove such metallic packing as are made of babbitt foil, spirally wound, it is not very difficult to screw into the packing itself with packing hooks made for the purpose and pull the packing out. With separate individual rings, which do not amalgamate with the other rings because of the laminated construction and lubricant between every sheet, the removal operation is performed with still greater ease.

So, all in all, the writer is convinced that the above chief engineer is considerably in the wrong. His case is analogous with that of the engineer who declared he would never install another centrifugal pump because he "tried one once" and it wouldn't pump enough water. The pump he had was all right for its capacity, but what the engineer needed was a larger capacity pump. However, the engineer couldn't "see it that way," because he had been prejudiced against "newfangled" equipment from the start and was determined to go back to the old form

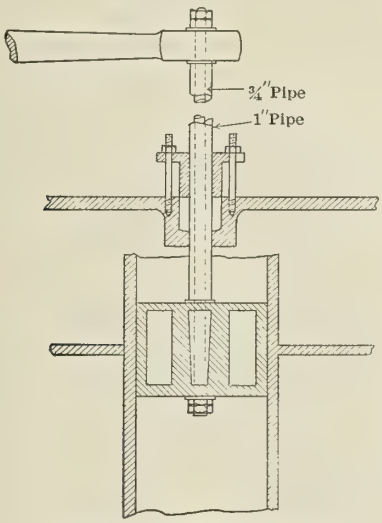
* Copyright, 1918, by W. F. Schaphorst.

of reciprocating pump, which was a steam waster, though he could speed it up when he wanted to pump a greater volume of water in a given time. W. F. Schaphorst.

Broken Circulating Pump Rod

The following account of a breakdown, namely, a broken circulating pump rod, and of the quick and efficient work of repairing that was made, may prove interesting and worthy of note to engineers—those who happen to be on small boats especially. Although the breakdown occurred on a small boat, the modus operandi could be applied also on fairly large steamers.

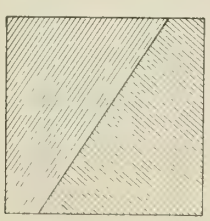
The circulating pump in question was driven off the pump levers (a plunger pump), with bilge and feed pump plungers at one end, air pump in the center, and circulating pump on the other end. When under way, the circulating pump rod broke in the middle. Having no spare rod on the ship, a speedy repair was made in the following manner:



Sketch of Broken Pump Rod

The rod was 1⅜-inch diameter and carried a solid brass bucket. A piece of ¾-inch screwed iron pipe was cut off the exact length of the rod, and, after screwing both ends, two check nuts were fitted on each end.

The length of the rod from the top of the bucket to the under side of the crosshead was made up by a distance piece of 1-inch pipe. By a little filing, the length of ¾-inch pipe was passed right through the bucket, the 1-inch distance pipe and the crosshead being secured by a washer with check nuts on top of the crosshead and two check nuts under the bucket. The 1-inch pipe, or distance piece, taking the place of the solid rod was filed up



Section of Packing

smooth to work through the packing in the gland. As this pipe was a trifle smaller in diameter than the solid rod, the gland was packed with square tucks packing cut, as shown in the sketch, which, when squeezed up by the gland, made it perfectly tight.

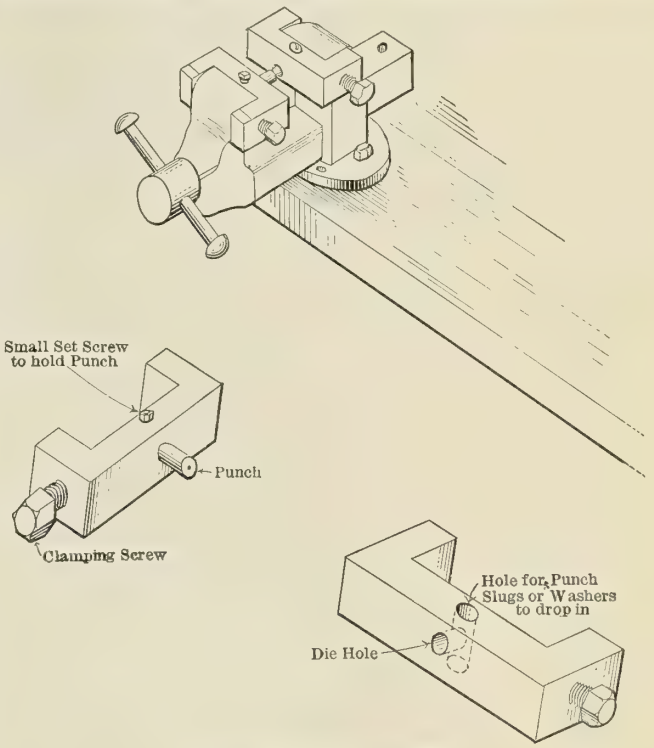
The pump did yeoman service for several days until a new rod was fitted. A glance at the section of packing will at once reveal the action of the packing in taking up the 1/16-inch slackness between the stuffing box and the rod.

A tug boat on this coast became a total wreck through her circulating pump rod breaking when making port in a heavy sea. When only half a mile from the entrance of the harbor, and, being disabled, she got in the trough of the sea before any repairs could be made and was washed ashore on the rocks, where she pounded herself to pieces.

Victoria, B. C. Edmund B. Dell.

Vise Punch Rig

For punching thin sheet metal, a handy little rig such as is shown in the sketches will do the work very well. It consists of two U-shaped pieces of stock fitted with common set screws for clamping them to the bench vise



Handy Vise Punching Rig

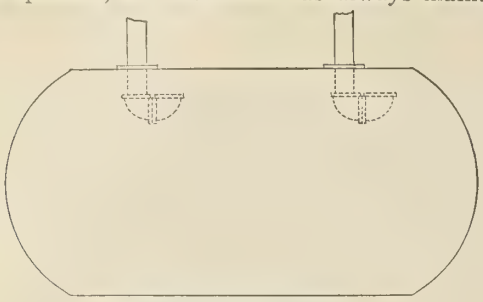
jaws, as shown. Anyone handy with tools can make up a set in spare time, and when one considers what mean work drilling thin stock is the value of a punch like this can easily be seen. C. H. Willey.

Curing Trouble from Noisy Return Lines

We had in service a large cylindrical tank into which discharged a number of drain lines from heating coils and straps. These originally were arranged to discharge flush into the tank, as shown in solid lines. However, in some conditions it was found that when returns were not coming back from one pipe while hot returns and steam were being discharged from others, the steam had a tendency to back up in the empty return pipes until a slug of cooler water was encountered coming back, when frequently a pronounced water hammer resulted.

In order to eliminate this trouble we decided that it would be necessary to install U seals in the various return lines, but before doing this we hit upon the scheme of water-sealing the outlets, as shown on sketch, merely by

the use of a long nipple and two elbows with the discharge pointed upwards, so that there was always maintained a



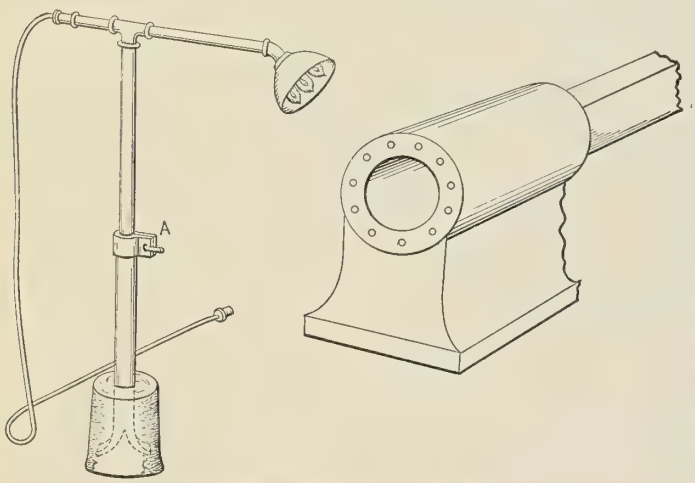
Water-Sealed Outlets

water seal at the ends of the return lines. The thing worked out all right.

Philadelphia, Pa. W. A. LAILER.

Portable Floor Light Stand

This stand will be found very useful for holding a floor light cluster. It is adjustable to any desired height and is very simple to construct, being almost entirely made from old worn-out pipe and fittings and a little cement or concrete.



Sketch Showing Light on Job

The end of the lower pipe is split and spread open to act as anchors in the concrete. The upper section of pipe telescopes into the lower.

A bit of flat stock is made into a clamp for use at A; it clamps the upper pipe tightly, and this clamp sets on the upper end of the lower pipe.

Concord, N. H. C. H. WILLEY.

Three Kinks That Have Proven Successful

I am sending you in this letter a few sketches which have proven to be successful and economical through their installations.

No. 1 represents a grease gun easily made by any engineer. The gun consists of a 3 by 12-inch pipe having a smooth bore, two pipe caps, a 14 by ¾-inch feed screw, handwheel and piston; also two grease cap filler pipes, as shown in sketch.

No. 2 represents a truss collar or ring which was made and installed between a large rotating boiler journal bearing to take up end thrust. As the journal bearing end shoulder was worn off ⅛ inch, allowing the boiler drum to run against the frame, the weight of the boiler being about 5 tons, it would have been very difficult to place a solid ring between bearings.

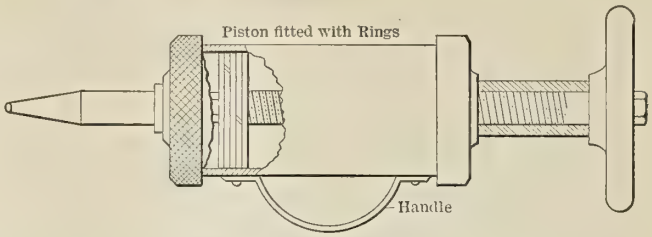


Fig. 1.—Grease Gun

The ring was made of brass 3/16 inch by 14 inches by 8 inches bore split through center, drilled and slotted, as shown. After placing the ring in position it was soldered together in the joints, which were counterbored and beveled.

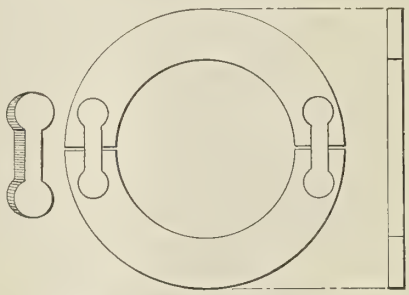


Fig. 2.—Truss Collar or Ring

No. 3 represents a gate valve and water release connection. Before the installation of the water release or drain valve and piping, trouble was always sure to develop when the gate valve on the main engine steam header line was opened, on account of the water having accumulated in the line. This resulted in causing the explosion of the boiler gate valve, releasing the steam from two 400-horsepower boilers at 165 pounds pressure. Since installing this improvement, no more trouble has been experienced.

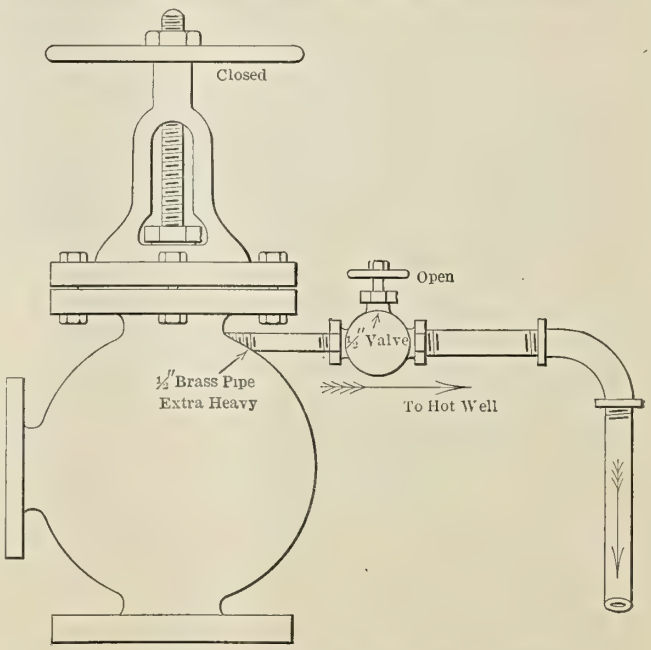


Fig. 3.—Gate Valve and Water Releasing Connection

The gage valve is first drilled with a 23/32-inch drill for a ½-inch pipe tap, 1¾ inches below top flange. A ½-inch by 4¼-inch extra heavy brass nipple is screwed onto a full thread and a ½-inch brass globe valve is attached to nipple. Connection from globe valve is made to the hot water well or feed water tank.

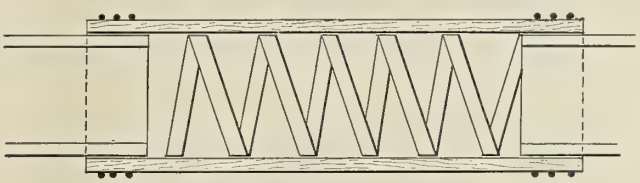
Operation

In operating this improvement, one valve is always closed and one open, so that when the gate valve is open the water release valve remains closed. When the gate valve is to be opened it is given a slow turn, allowing the live steam to expel any and all water from line and valve. The water release must be tightly shut when the gate valve is opened.

Stillwater, Minn. Otto Dorthen.

Hose Kink for Suction Lines

On board ship it is often very desirable to use hose on the various suction lines because of the flexibility offered, etc. The writer had one experience in connection with a 4-inch water suction line. A flexible joint was necessary and a piece of light rubber and canvas hose was inserted between the two pipe ends, but when the pump started sucking, the walls of the hose were so thin that they could not withstand the air pressure from without and the walls collapsed.



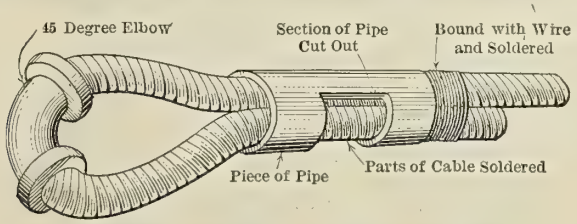
Spring Distender for Hose

To prevent these we took a stout piece of wire, bent it in the form of a spring to fit the inside of the hose, as shown in the sketch, and fastened it there. This wire support served nicely to hold out the walls of the hose while under suction pressure. The same arrangement can doubtless be used by other engineers who are forced to use poor grades of hose or light hose on suction lines.

Philadelphia, Pa. W. A. Lailer.

Cable Eye Kink

Sometimes there is need to put an eye in a hoist cable or sling, and no time is available to put in a splice, or perhaps no one at hand knows how to do it successfully. The



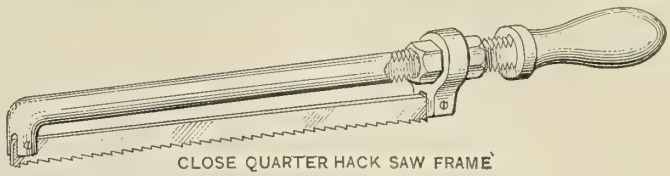
Splicing Emergency Eye for Use in Cable

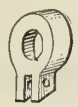
idea shown in the sketch will be found very handy to such fellows and it may be worth adding to their note books.

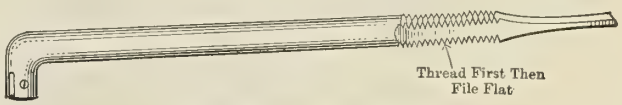
Splicer.

Close Quarter Saw

Often there is need to use a hack saw in very close quarters, and to meet this need this home-made frame was made. Its construction is very simple. The material needed is but a short length of ⅜-inch round rod and a







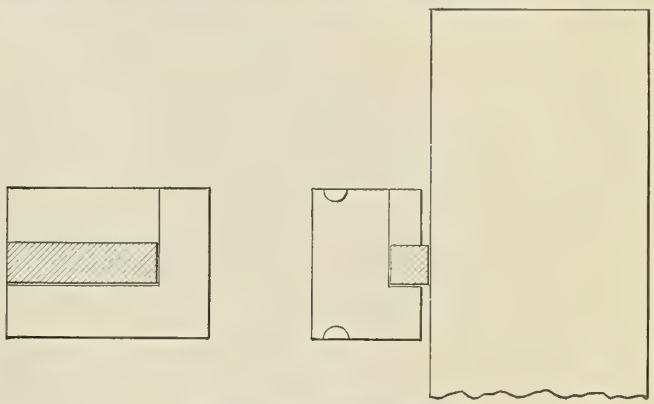
Details of Close Quarter Saw

bit of flat stock with which to make the crosshead. One end of the rod is bent short at right angles and a slot cut to take the blade. The other end is threaded for a few inches and then two sides are filed flat to take the cross head and the file handle. Further details are given in the sketch.

C. H. Willey.

Facilitating the Grinding Down of Steel Keys

The engineer is frequently called upon to grind down to size keys for attaching flywheels, pulleys and pinions to



Device for Grinding Keys

a shaft. Where this work is attempted on a grindstone it is possible to secure a bad burn from the overheated metal and to secure an unevenly ground surface unless a proper device is used to hold the key. One of the most satisfactory methods is to take a small block of wood about 4 inches long by 2 inches wide and 2 inches deep and cut out one corner, as shown in above sketch, into which the key can be placed and rigidly held against the stone without fear of being burned by the heat generated and with the assurance that a fairly even finish will be obtained because of the even surface against which the piece of metal is held.

Machinist.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY H. A. EVERETT

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Sag of Wire in 200-Foot Span

Q. (980).—I have a line to run of about 200-foot span. Can you give me the sag of the wire or a method of computing it?

A. (980).—If you use a No. 27 gage steel piano wire attached to a fixed point at one end, and at the other passing over a roller and loaded with a weight of 52 pounds, the sag at 10-foot intervals, as experimentally determined, is as follows:

Distance		Sag
10 feet and	190	11/64 inches
20	180	21/64
30	170	29/64
40	160	37/64
50	150	11/16
60	140	49/64
70	130	53/64
80	120	7/8
90	110	29/32
100		29/32

Formula for Computing Size of Main Steam Pipe

Q. (973).—What is the formula for computing the size of the main steam pipe from the boilers to a Parsons steam turbine?

A. (973).—Seaton gives the following, which is based on an allowed steam speed through the pipe of 8,100 feet per minute:

$$\text{Diameter (ins.)} = \frac{\text{Diameter of high-pressure cylinder (ins.)}}{90\sqrt{\text{Piston speed (feet per minute)}}}$$

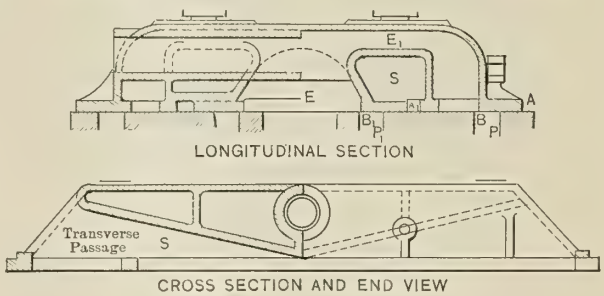
Present practice in turbine installations is to accept a lower allowable steam speed of about 4,500 to 6,500 feet per minute, as it was found that there was considerable loss of pressure from boiler to throttle with the higher speeds. The lower velocity should be used with small pipes.

Double Ported Slide Valve

Q.* (976).—What is a double ported slide valve and the reason for using this style of valve?

A. (976).—In a reciprocating engine of large power, therefore requiring a large amount of steam, the necessity of providing large passages for the free flow of this steam into and out of the low pressure cylinder, requires some modification of the ordinary type of *D* slide valve. If the slide valve type is retained, the additional area of steam passages required may be provided for by doubling the travel of the normal D type of slide valve and widening out the ports of the cylinder or by keeping the travel the same and providing an additional set of ports governed by another valve made an integral part of the D valve. This latter is the usual solution and results in the double ported slide valve, which is really nothing more than a large slide valve of the D type, straddling a smaller one, each operating over its own admission ports and with the exhaust entering a common chamber and discharging through the regular exhaust passages, as can be seen in Fig. 1.

Steam surrounds the outside of the valve and enters port *P*, going by edge *A*, when the valve is displaced to



the left. The passage *S* connects directly to the steam space so at the same time admission occurs in the port P_1 past the edge A_1. When the valve is displaced to the right, as shown, exhaust occurs from both *P* and P_1 to *E* and E_1, which unite, as shown, and deliver to the common exhaust.

Slip

Q.* (977).—Propeller is 12 feet pitch; engine making 100 revolutions per minute; ship making 10 knots. What is the slip?

A. (977).—

$$S = \text{slip (expressed as a decimal)} = \frac{PR - V}{PR}$$

When P = pitch of propeller in feet
R = revolutions per minute
V = speed in feet per minute

$$S = \frac{12 \times 100 - \frac{10 \times 6{,}080}{60}}{12 \times 100} = \frac{1{,}200 - 1{,}013}{1{,}200}$$

$$= .156 = 15.6 \text{ percent.}$$

If V is expressed in knots, $S = \frac{PR - 101.3\,V}{PR}$.

Rule for Tonnage of Ship

Q. (978).—Can you give me an approximate rule for the determination of tonnage of a ship from her principal dimensions?

A. (978).—The following expressions will give reasonalby close estimates of gross tonnage for normal types freight and intermediate steamers. They are the result of curves drawn in my office, using the data from a large number of ships. and have not been published heretofore:

Three Deck Type

$$\text{Approximate gross tonnage} = \frac{0.79 L \times B \times D + 5 l \times B}{100}$$

L = length between perpendiculars,
B = molded beam.
D = depth from top of tank to upper deck at side,
l = combined length of bridge, poop and forecastle.

Shelter Deck Type

$$\text{Approximate gross tonnage} = \frac{0.86 L \times B \times D + 5 l \times B}{100}$$

L = length between perpendiculars,
B = molded beam.
* D = depth from top of tank to upper deck at side,
l = combined length of bridge, poop and forecastle.

* Upper deck is deck below shelter deck.

Marine Technical Publications

Q. (982).—Please give a list of the principal marine technical publications?

A. (982).—Some of the major publications are given below:

Marine Engineering, monthly, Aldrich Publishing Company., New York City, $2.00 per annum.

Journal of the American Society of Marine Draftsmen, quarterly, Washington, D. C., $1.00 per annum.

Journal of the American Society of Naval Engineers, quarterly, Navy Department, Washington, D. C., $5.00 per annum.

Marine Journal, weekly, 17 State Street, New York City, $2.00 per annum.

Marine Review, monthly, Penton Publishing Company, Cleveland, Ohio, $2.00 per annum.

United States Naval Institute Proceedings, Naval Academy, Annapolis, Maryland, bi-monthly, $3.00 per annum.

Transactions of the Society of Naval Architects and Marine Engineers, annually, 29 West 39th Street, New York City, $10.00 per annum.

Transactions of the Institute of Engineers and Shipbuilders in Scotland, issued irregularly, Glasgow, Scotland.

Transactions of the North East Coast Institution of Engineers and Shipbuilders, monthly, Newcastle-upon-Tyne.

Shipbuilding & Shipping Record, weekly, London, S. W. I., £1, 12s.

Engineering (London), weekly, 35 Bedford Street, Strand, London, W. C., £2, 9s, 6d.

Motor Ship and Motor Boat, weekly, 7-15 Rosebery Ave., London, E. C., 17s, 4d.

NEW BOOKS

The Submarine in War and Peace: Its Development and Possibilities. By Simon Lake, M.I.N.A. Pages, 9 by 5½ inches. Illustrations, 71, including a chart. Philadelphia, 1918: J. B. Lippincott & Company. Price, $3 net.

Simon Lake, the inventor of the Lake submarine, which has played such a great part in the war in the navies of the world, has given in this book a guide for those who wish to know more of the submarine, its mechanism and possibilities. The romance of submarine inventions is a tale well worth telling, and in describing the evolution of the submarine Mr. Lake has set forth lucidly the wisdom gained from many years' experience of successful submarine invention.

To-day the submarine is a factor in the political and industrial life of the world, carrying possibilities of the most astonishing nature. Among the many wonders which the war has brought vividly to our attention, no other, save the aeroplane, is so full of romantic interest as the submarine. Between them, these two agencies are likely to revolutionize the life of the world in many ways. Chapter VI, which discusses the possibility of defeating the submarine, will be read with the keenest attention. No one is better fitted to discuss this subject than this greatest of marine engineers.

Previous to its publication in book form, much of the material contained therein appeared in the columns of Marine Engineering.

The author shows that as a commercial carrier, in hydrographic work, scientific exploration, navigation under ice fields, etc., the industrial possibilities of the submarine are of great moment and that the submarine is destined to protect the weak and serve humanity in general in many ways. The book is generously illustrated and readable from beginning to end.

Rust's Practical Tables for Navigators and Aviators. By Captain Armistead Rust, U. S. Navy. Philadelphia, 1918: John E. Hand Sons Company. Price, $3.50.

In this small volume, published by members of the United States Naval Reserve Force in the Fourth Naval District for the benefit of those who aspire to a commission, are contained new tables and diagrams that afford short cuts for performing the necessary calculations in working traverse problems, plane sailing, correction of observed altitudes, dip table for aviators, ex-meridian altitude tables, the time at sea, Sumner lines, the Marcq Saint-Hilaire method, identification of stars, great circle course and distance, finding the azimuth of any body.

Every aspirant for a commission in the naval service or for an officer's position in the merchant marine, as well as every captain and navigator afloat, will find this book of valuable assistance in his work. All problems in practical navigation may be solved by it, and in most cases many pages of Bowditch, etc., are reduced to a single diagram or to a page or two of the new tables.

Maximum Base Prices, Differentials and Extras on Iron, Steel and Non-Ferrous Products. Size, 6 by 8¼ inches. Pages, 78. Charts, 3. Cleveland, 1918: The Penton Publishing Company. Price, $1.

This booklet gives complete schedules of maximum prices on iron, steel and non-ferrous products as fixed by the Government which are now in effect. Owing to the numerous changes during the past six months, which have rendered practically obsolete similar lists previously issued, this up-to-date price manual will be found especially useful.

Practical Design of Marine Single-Ended and Double-Ended Boilers. By John Gray. Size, 5 by 7¼ inches. Pages, 84. Illustrations, 21. Plates, 4. New York, 1918: D. Van Nostrand Company. Price, $1.25.

This book is intended as a guide to draftsmen and engineers who are already familiar with similar types of boilers, but lack the experience necessary to design large single- or double-ended boilers. In it will be found illustrations and a complete description of the detailed design of 3 and 4-furnace single-ended and double-ended Scotch boilers and also the Inglis patent boiler.

A worsted tassel oiler on a horizontal piston rod is a most satisfactory rig. If you have never seen one ask about it. It will come in handy sometime, perhaps, to know about it.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

NEW SHIPYARDS AND EXTENSIONS OF EXISTING YARDS

Additions, Improvements, and Orders for New Equipment

The Pacific Shipbuilding & Terminal Company has been incorporated in California to operate a yard in the vicinity of Long Beach. Among the incorporators are Malcolm H. Murray and W. Frank Fisher, of Los Angeles.

The Emergency Fleet Corporation has authorized the construction of twelve new shipways at the yards of the Pusey & Jones Company, Gloucester City, N. J.

The Cholberg Ship Company will build a yard at Victoria, B. C., where it will construct wooden vessels.

The Jacksonville Dry Docks & Repair Company has been incorporated, with headquarters at Jacksonville, Fla. The incorporators are E. F. Terry, J. W. Hollister and S. L. Walker, all of Jacksonville. These men have also incorporated the Brittain Shipbuilding Company, to build steel vessels.

The United States Shipping Board is planning the construction of a dry dock at San Pedro Harbor, Los Angeles, Cal.

The Greenport Ship Company has purchased the property of the Radel Oyster Company, Greenport, L. I., and is planning to build steel trawlers and to repair fishing craft.

Announcement has been made by the United States Shipping Board that a 10,000-ton dry dock and repair plant will be built at New Orleans.

The North River Ship & Engineer Corporation has been organized to operate a shipyard. The incorporators are M. Metkiff, E. P. Schonburg and P. D. Denison, 154 Nassau street, New York.

The West Seattle Boat & Engine Company has been incorporated by H. H. Guth and H. A. Bernardo, Seattle, Wash.

The Downing Marine Construction Company, 17 Battery Place, New York, has plans for a yard at Sea Cliff, L. I., where it will build steel barges for use on the New York State Barge Canal. The company already has an order to build nineteen of these barges, which will be 150 by 20 by 12 feet.

The Pacific Marine Corporation has been incorporated in California, and is building a plant at San Diego. The organization will be operated by the Scofield Engineering Company, of Philadelphia and San Francisco, and will build concrete-steel vessels.

The Canadian Allis-Chalmers Company, Toronto, Can., state that they can fill six berths before June, 1919, and will begin work as soon as berths become vacant.

Shipbuilding Contracts Awarded by the Shipping Board

The United States Shipping Board, Emergency Fleet Corporation, Washington, D. C., has awarded contracts as follows:

To the Seaborn Shipyards Company, Tacoma, Wash., P. J. Anderson, purchasing agent six more ships of the Ferris type, making a total of fourteen ships of this type for which the Seaborn Company has orders.

To the Wright Shipyards Company, Tacoma, Wash., George P. Wright, president, two ships of the Ferris type.

To the Pensacola Shipbuilding Company, Pensacola, Fla., six 9,000-ton steel steamships.

To the Marine Department of the Houston Bank & Trust Company, Houston, Tex., two concrete ships, each of 1,600 tons deadweight capacity.

To the Lake & Ocean Shipbuilding Company, Cleveland, Ohio, three sea-going tubs.

To the American Lumber Company, Panama City, Fla., eight 2,500-ton sea-going wooden barges, at its new shipyard in Millville, Fla.

To the Nilson & Kelez Shipbuilding Company, Seattle, Wash., John Erickson, president, two more 3,500-ton wooden ships.

To the Biddeford Shipbuilding Company, Biddeford, Me., a 3,000-ton wooden barge.

To the Universal Shipbuilding Company, Sturgeon Bay, Wis., which took over the wooden shipyard of Rieboldt, Wolter & Company, three sea-going tugs. This yard is also preparing to build steel vessels.

To the Richard T. Green Company, Chelsea, Mass., a large number of 240-foot coal barges.

To the Bethel Marine Railway, Bethel, Del., two 2,500-ton wooden sea-going barges.

To the Midland Bridge Company, Houston, Tex., eight 3,500-ton wooden steamships.

To the Ames Shipbuilding Company, Seattle, Wash., Edgar Ames, president, fourteen 8,800-ton steel steamships.

To the Atlantic, Gulf & Pacific Company, 13 Park Row, New York, eight three-masted wooden coal-carrying schooners, to be built at a new yard on Mill Island, Jamaica Bay.

Savannah Firm Will Build Oil Tankers for Government

Preparations are being made to lay the keel of the first of ten oil tankers to be built by the Terry Shipbuilding Corporation, of Savannah, Ga., for the Emergency Fleet Corporation.

The contract for the ten tankers is understood to represent a total of about $16,000,000, the cost of each vessel being $1,600,000.

ITALIANS STRIVING FOR QUALITY NOT QUANTITY IN SHIPBUILDING

Plan to Build 500,000 Tons a Year

An article which recently appeared in *Giornale d'Italia* discusses the prospects for the Italian shipbuilding industry after the war. The old Italian shipbuilding yards, it says, which were extended immediately after the beginning of the war, will be able to turn out more than half a million tons of cargo boats per annum, and in two years they will be more than able to bring the Italian mercantile fleet up to its pre-war standard. In four years they will be able to double the size of the fleet, but that will still be inferior to Italy's needs.

"We must not even think of competing with England and America in quantity of production. That would be absurd. We must equip our yards not only for cargo ships, but also for mixed vessels for carrying both cargo and passengers. It is a different form of construction, finer, and one which demands more labor, and therefore one which is better suited for us."

For this class of vessel there will be a great demand, because the war has also played havoc with passenger ships, especially for the transport of troops. And there seems to be no reason why, with this type of ship, fine, elegant, well planned, Italy cannot enter into competition even with England and America.

Shipments of Steel Plates and Other Forms of Steel to Be More Closely Supervised

In order to remedy the inequalities that have existed thus far in the service given the shipyards by the steel mills a new blank or form of report has been issued by the Director of Steel Supply at Washington. On this report the requirements of steel of the various forms for each month, as determined by the Emergency Fleet Corporation, and sanctioned by the Director of Steel Supply, are shown in one column and against these amounts actually shipped.

Ferris Type Ship Framed in Fifty-nine Hours

The framing of a Ferris-type ship by 60 men in 59 working hours is a feat accomplished by the Cumberland Shipbuilding Company, Portland, Me.

The work was done on United States Shipping Board Emergency Fleet Corporation Hull No. 386. All of the 71 square frames, together with the stern post and the 60-foot keelson, were permanently erected by four framing crews of 12 men each, 6 riggers and 6 setters-up.

PACIFIC COAST MERGER

Four Million Dollar Deal in Shipping Closed

The Pacific Steamship Company, according to recent reports, has taken over the entire passenger and cargo fleet owned by the Pacific Coast Company. The absorption of the Pacific Coast Company brings under the control of the Pacific Steamship Company a unified fleet, and it is believed that the latter company will make an effort for traffic to the Orient, South America, Australia and possibly other trades after the war.

Operated Under One Flag

With the consummation of the absorption the Pacific Coast Company will retire from the ocean. Until November 1, 1916, it operated its vessels under the name of the Pacific Coast Steamship Company. It then entered into an agreement with the Pacific Alaska Navigation Company, by which the fleets of the two corporations were merged and placed in operation under the flag of a new company, now well known and well established as the Pacific Steamship Company.

Vessels Involved

The vessels involved in the new deal include the *President, Governor, Senator, Queen, City of Seattle, Spokane, City of Topeka, Curacao, Ravalli* and *Homer,* the latter operating in the California coast trade. The *Umatilla,* another Pacific Coast ship, was wrecked several months ago on the Japanese coast.

The original fleet includes the *Admiral Dewey, Admiral Evans, Admiral Farragut, Admiral Wainwright, Admiral Nicholson, Admiral Watson, Admiral Schley, Admiral Godrich, Admiral Sebree* and the *Aroline.* Recently the Pacific Steamship Company purchased the auxiliary-powered schooners *Admiral Sims* and *Admiral Mayo* as a means of extending its transportation operations.

Take Over Entire Plant

The Universal Shipbuilding Company, Sturgeon Bay, Wis., has taken over the entire plant and equipment of the Hess Iron Works, Inc., and will erect several buildings to effect a transfer of the works to its shipbuilding plant. W. J. Hess, general manager of the Hess Iron Works, joins the Universal company as superintendent of fabricating and boiler manufacture. The purchase will enable the Universal company to accept contracts for steel vessels. The company at present is building ocean-going tugs for the Government. These tugs are to be 150 feet long, with 30-foot beam and 16½-foot draft. They will be driven by triple-expansion engines.

Bids for New Plant

Bids are about to be taken by the Weehawken Drydock Company, Weehawken, N. J., for the erection of a shipbuilding plant to be erected at Peekskill, N. Y.

Town Grows With Shipyard

Pascagoula, Miss., which for years was merely a small village on the shore of Mississippi Sound, has increased to 20,000 permanent population by the establishment of the Dierks-Blodgett, the International and other shipyards there. Moss Point, formerly a swamp, with a few houses and stores, a short distance from Pascagoula, has passed the 5,000 mark and is driving on to 6,000 as the result of the establishment of the Dantzler and Hodge and other yards.

Special Shipworkers' Train

The Emergency Fleet Corporation has arranged with the Louisville & Nashville Railroad for a special shipbuilders' train to ply between Biloxi and the shipyards at Pascagoula, both in Mississippi. Shipyard workers at Moss Point, a suburb of Pascagoula, where there are several yards, are enabled to connect with this train by means of an electric car line which connects the two towns. This train will carry the workers from the yards of the Dierks-Blodgett Shipbuilding Company and the International Shipbuilding Company at Pascagoula, and the Dantzler and Hodge companies at Moss Point. More than 3,000 men are employed at the Pascagoula yards and more than 2,000 at Moss Point.

Recent Launching

The Alabama Drydock & Shipbuilding Company, Mobile, Ala., recently launched a 10,000-ton mine sweeper and a 2,500-ton composite ship.

Shipyard Loafers Become Good Workers Through Novel Idea Suggested in Spirit of Fun

Ship workers at the plant of the Los Angeles Shipbuilding & Dry Dock Company have adopted as their slogan "Don't Delay the Ships." This slogan, however, is not only a battle cry but a command which each workman is required to obey in spirit and in deed. To enforce their edict the men have established a tribunal known as "The Court," which for effectiveness and originality is a marvel.

Created in a spirit of fun, this court has long since ceased to be a mere means of amusement. Instead, it has been converted into an effective agency for speeding up the work, and is a real menace to those who might be disposed to take things easy and let the other fellow hustle.

The court is presided over by the head of the shipwright department, and reaches to all departments of the shipyard. Each defendant is given a fair and impartial hearing at sessions held during the noon hour. The full power of the judicial body is given him in the matter of summoning witnesses. Counsel is provided for those who demand it. If the accused be found guilty he is "executed" in public, usually before an audience of hundreds of his fellows.

Harking back to the witchcraft days of the old Massachusetts colony, "The Court" has taken for its instrument for punishment the ducking-stool. The number of immersions is regulated according to the seriousness of the offense. One trial and sentence is usually enough; as yet there have been no second offenses.

Argentina Shipping Active

Owing to the reorganization of the important river fleet of Nicolas Mihanovich, tending to a redistribution of the fleets, the company has recently added to its fleet the *Leda* of 570 tons, the *G. B. Vierci* of 578 tons, two tenders, two launches and a tug—seven boats in all at a cost of $153,400.

It is reported that the steamer *Benjamin,* of 1,117 gross tons, belonging to Messrs. Larraerrea, Milans y Cia., has been sold at a high price, and that the vessel will be placed on the route from Buenos Aires to Barcelona. This vessel was built in 1902.

It is also reported that the fleet known as the Lambruschini fleet has been sold to Señor Debernardir, Montevideo, for $340,655, consisting of four tugs, four schooners, all under 400 tons, and other small vessels. It is understood that the owners, known as La Naranjera Rosarina S. A., are considering an offer for their fleet, consisting of eight river boats.

Experiments are being made with rafts on the Parana, in view of the high price of vessels. Recently a raft constructed by Messrs. Nnñez, Gibaja, Martinez y Cia., some 80 meters in length and 17 meters in width, arrived in Rosario carrying 2,000 metric tons of cedar, lapacho and other wood for Buenos Aires. Many delays were met in the passage, but it i sbelieved this form of transportation will prove practicable in handling timber from Formosa and the Chaco.

London Shipowners' Society Head Urges England to Declare Ship Policy

J. Howard Glover, chairman of the London General Shipowners' Society, in the course of his address at the recent annual meeting of that body, strongly urges England to name its ship policy. Mr. Glover spoke in part as follows:

"I hope my successor next year may be able to give us some words of light and leading as to the future of our trade. To me it is all dark at present. The Government is now owner of a great many cargo ships, and the newspapers tell us that when the programme is complete 500 ships will be owned by the Shipping Controller.

"What is the policy of the Government with regard to these ships and their control of trade? Has not the time arrived when we should be enlightened as to this? One result of Government control is that a large number of shipowners have been permitted to sell off their fleets and go out of business, and some have lost nearly all their ships through enemy action.

"It seems to me that the Government should endeavor now to sell the standard ships, so as to enable the shipowners to preserve their business and personnel. I think ,if it is possible, it would be a wise course, and I am certain from a financial point of view alone—apart from any others—it is the interest of the nation that these ships should be sold now.

"We hear of the enormous preparations for the production of ships—in this country, in the United States and in Japan. The figures mentioned are colossal, and, if true, will take but a very short time for the world's tonnage to more than recuperate all the losses

caused by enemy action. I think we may be faced with a difficult situation in the near future which will require very careful handling.

"It should be the first duty of the Government to preserve the shipping trade of the country, and to foster by every means in its power the trade of shipowning and shipbuilding, and I must not forget ship broking and all that this important branch includes. For the past two years this essential department of the shipping trade has been paralyzed.

"The greatness of this Empire has been built up by the fact that our mercantile marine are the carriers of the world. It was ships that made India and made our Colonial Empire. If the day should come when the supremacy of the carrying trade of the world passes from this Island Empire to others, a very serious situation would arise.

"I cannot end without saying that I think the Government's attempts to be merchants, shipbuilders, shipowners and ship brokers—all directed from Westminster—have not been, and are not, conducive to the advancement of the nation or the preservation of the vital interests of this Empire, and that every effort should be made to relinquish all the controls at the earliest possible moment. A beginning can easily be made now by the authorities ceasing to be shipowners."

War Emergency Courses in Employment Management

Intensive training in employment management for men and women having a basic experience of at least three years' industrial experience and knowledge of factory methods has been arranged for in the following universities: Harvard University; Massachusetts Institute of Technology; Boston University; Bureau of Municipal Research, Rochester, N. Y.; University of Rochester; Carnegie Institute, Pittsburgh; University of Pittsburgh; University of Washington, Seattle; University of California, Berkeley. Courses are also in preparation at the University of Cincinnati and at the University of Chicago.

The courses, which run from six weeks to two months, are conducted by the Employment Management Division of the War Industries Board, under the auspices of the Department of Labor, the War Department, the Navy Department, U. S. Shipping Board and the Chamber of Commerce of the United States.

No tuition fee will be charged. Employers having candidates for the courses and individual applicants desiring information should address Captain Boyd Fisher, Employment Management Division, War Industries Board, 717 Thirteenth street, N. W., Washington, D. C.

Emergency Fleet Corporation to Build 75 Deep-Sea Trawlers

Owing to the loss in vessels and small producing units which American fisheries have suffered through the war, and particularly by naval drafts, the Emergency Fleet Corporation, at the request of the United States Food Administration, has authorized the construction of a fleet of 75 deep-sea trawlers of the most modern type. These vessels, through arrangements with the fishing industry, will be put into operation early in 1919 on both the Atlantic and Pacific coasts.

All Contracts Cleared Through Fleet Corporation and War Industries Board

According to a recent ruling, in future each Government agency shall prepare its own plans and specifications for such ships or other water craft as it may require, conferring and collaborating from time to time with other interested agencies, to the end that uniform standards as nearly as practicable shall be adopted.

If an agency of the Government other than the Emergency Fleet Corporation desires and requests it, the corporation will, where practicable, undertake to construct, or to have constructed, proposed vessels according to the plans and specifications prepared by the agency.

In any event *no contracts for the construction of vessels will be placed by any such Government agency until they have been cleared through the Emergency Fleet Corporation and through the War Industries Board.* In the event of disagreement between the agency proposing the construction and the Fleet Corporation the controversy shall be adjusted or decided by the War Industries Board.

Through pursuing this course the activities of all of the different agencies of the Government interested in the construction of water craft will be coordinated, competition will be eliminated, and conflicts in supplies of materials, transportation, power, fuel and labor will be avoided.

Shipping Men Fear Loss of Technically Trained Men Through Increase of Draft Age Limit

Widening of the age limits of the draft to include all men between eighteen and forty-five years is causing much concern among shipping companies of this city whose organizations have already been impaired through the enlistment or drafting of many of their employees. Some difficulty will be caused by the induction into service of those under twenty-one years, but these can probably be replaced by women workers and those who may be exempted from the draft. The chief anxiety is felt because the upward extension of the age limits will bring within the scope of the draft a large number of the older and more experienced men occupying positions of high responsibility.

There is no disposition among shipping men to seek exemption of men whose services can be dispensed with, or for whom substitutes can be found. The business, however, is highly technical, and executive, or even semi-executive, positions cannot be filled from the ranks of untrained applicants, according to the experience of the trade to date.

Newburgh Launches First Overseas Craft

A 9,000-ton freight carrier, the first transatlantic steel ship to be built on the Hudson River, was launched from the Newburgh shipyards early in September. This yard now has under construction nine other ships, four of which are rapidly nearing completion.

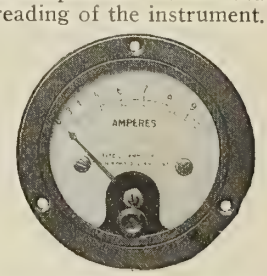
Shortly after Hull No. 1 left the ways the keel of No. 6 was laid on the smoking incline.

Meters for Wireless High-Frequency Work

A high grade hot wire measuring instrument, designed particularly for wireless and other high frequency work, has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

This conducting strip, made of special non-corrosive material, has a slight sag, which is magnified several hundred times on the scale by means of a combination of wires and a deflecting spring. The meter depends for its operation upon the expansion of a metal strip which is heated by the current to be measured.

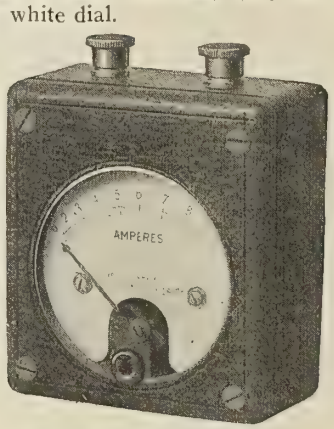
The separating posts have the same temperature coefficient of expansion as the conducting strip, so that the changes in room temperature do not cause error in the reading of the instrument.



Type E H Switchboard Ammeter

These instruments are furnished in two forms—for flush mounting and portable. Similar instruments for switchboard mounting are also supplied.

The flush-mounting form, known as type EH, is of the round, open-face type. The face is 3 inches in diameter, and the diameter outside the flange is 3¾ inches. It has a black rubberoid case and rim, with white dial.



Type P H Portable Ammeter

The portable form, known as type PH, is mounted in a morocco-leather-covered wooden case with heavy glass over the dial. The case is 3¾ inches by 4⅜ inches by 2 inches thick.

Type EH meters have a guaranteed accuracy of 2 percent; while type PH, with hand-marked scale, can be expected to show an accuracy within 1 percent of full scale. Standard meters are for 1, 3 and 5 amperes. Care must be used not to subject the instrument to more than 200 percent load.

The scale plate is made of metal, and the scale subtends an arc of 90 degrees, being 2⅜ inches long.

Bonar Law Analyzes Shipbuilding Situation

In introducing the record vote of credit for £700,000,000 in the House of

Commons recently, Bonar Law pointed out that the national expenditure instead of exceeding the estimates was under them. Analyzing the figures from the beginning of the financial year up till July 30, he said that, on the assumption that the expenditure was spread equally over the whole year, the amounts would have come to £726,500,000. The actual expenditure was £724,000,000, so that the estimate had not been reached to the extent of £2,500,000, equivalent to £24,000 per day.

Honor Badges for Ship Workers at Foundation Yard

Immediately after the double launching of the steamships *Bologan* and *Bugaya* on August 29 at the Passaic River yard of The Foundation Company, honor badges were presented by representatives of the U. S. Shipping Board to the men who had been employed continuously at the yard since the keels of

Honor Medal for Ship Workers

these ships were laid. The men at the Passaic River yard are the first, it is claimed, to receive recognition from the Shipping Board for faithful service by the presentation of badges shown herewith bearing the names of the ships upon which the men have worked.

According to the present honor roll system, 1,251 men were entitled to honor badges. The presentation of these badges was an unusual and interesting feature of the launching ceremony.

Shipping Board Takes Over Lake Steamer "Missouri" for Training Ship

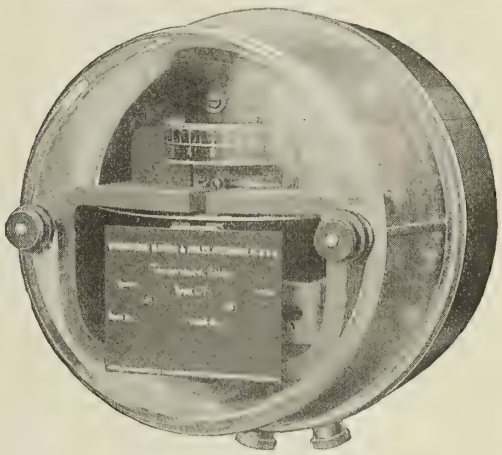
The Shipping Board announces that it has taken over the lake steamer *Missouri* as a training ship for merchant marine apprentices on the Great Lakes. The steamer, which will accommodate about 300 recruits, besides necessary officers and instructors, is now at Milwaukee. It will be stationed at a training base at Cleveland, under the supervision of Captain Irving L. Evans, of that city, section chief of the Board's recruiting service, and will cruise in the different lakes. Men trained on her will be given supplementary training on lake cargo carriers before they are sent to seaports for service on overseas and coastwise ships.

Making Temperature Trip the Circuit Breaker

The oldest form of overload protection is electromagnetic, cutting off the current if it reaches a value deemed dangerous. The fact that most electrical apparatus can withstand momentary overloads without danger has gradually led operators to push up the current values at which electromagnetic protective devices will operate, or to dispense with them entirely, rather than undergo the inconvenience of having them disconnect the machinery on momentary peaks.

A method of visual protection on the basis of temperature was the next step. Exploring coils were built into the apparatus, and used to indicate the temperature of hot spots by means of electrical instruments.

The latest step is a relay, the type CT, built by the Westinghouse Electric & Manufacturing Company, East Pitts-



Westinghouse Relay Circuit Breaker Actuated by Temperature

burgh, Pa., which automatically trips the circuit breaker when the temperature reaches the danger point under excessive current. It may be used to protect any alternating current apparatus from excessive heating if the apparatus is so arranged that exploring coils can be installed.

The relay is intended to protect apparatus against overheating from sustained overloads. To afford this protection with the least interruption of service the breaker should be tripped through the direct effect of the temperature of the apparatus. The relay should be so arranged that it prevents the breaker from tripping if the overload is of such short duration that the temperature does not rise to a dangerous value; while if the overload persists the breaker must be tripped out as soon as the temperature rises beyond the critical value. This is accomplished in the type CT relay as follows:

The type CT temperature relay operates on the wheatstone bridge principle. Two arms of the bridge are copper exploring coils, arranged to be placed in the oil or embedded in the windings of the apparatus to be protected, the other two arms are unchanging resistance mounted in the relay. The current for the bridge is supplied by the current transformer connected in the circuit of the apparatus to be protected.

The relay has two windings, corresponding to and co-operating to produce torque in a manner similar to the current and voltage coils of a wattmeter. The main winding is a coil operated directly by the current transformer. The auxiliary coils are connected to the wheatstone bridge arms similarly to a galvanometer connection, and thus receive current, the magnitude and direction of which depend upon the resistance of the search coils.

Above a certain temperature the torque of the relay is in the contact direction, and below in the opposite direction. It will thus be noted that in order to close the contact, two predetermined conditions must co-exist—excess current and excess temperature. Neither one will separately trip the relay.

The type CT relay is similar in construction to the other Westinghouse types, except that it has special windings and two additional terminals.

The construction of the exploring coils will vary, depending on the kind of apparatus with which they are to be used.

STEAMSHIP MEN MEET

At the annual meeting of the American Steamship Association, held recently at 17 Battery Place, the following officers were elected for the coming year: President, H. H. Raymond; vice-president, Edward J. Barber; secretary and treasurer, W. M. Brittain, and attorney, Edwin H. Duff. The executive board selected consists of H. H. Raymond (chairman), H. F. Alexander, G. S. Dearborn, P. A. S. Franklin, Edward J. Barber, F. D. Mooney, W. H. Pleasants, Alfred Gilbert Smith, H. B. Walker and D. T. Warden.

The association comprises more than sixty members, representing steamship owners on the Atlantic, Pacific and Gulf coasts.

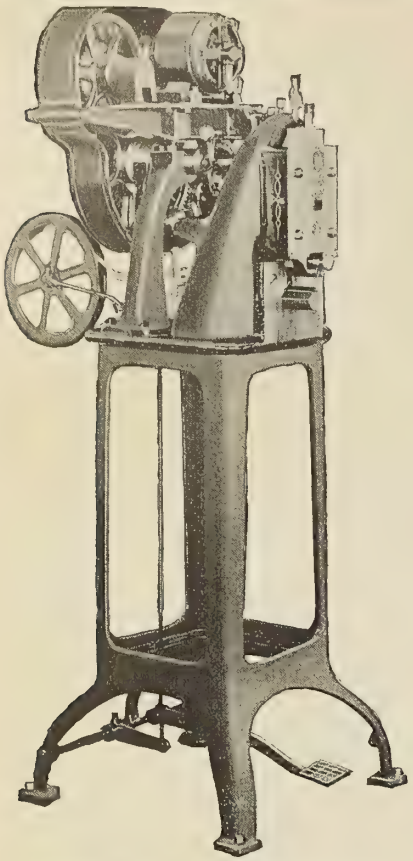
Box Corner Staying Machines

The Knowlton corner staying machine makes a strong and high-grade box by welding the sides of the box and the stay together under great pressure, forming a corner stronger than the board. The board is neither punctured nor weakened, but stiffened by the continuous fastening, and reinforcement is secured at each box corner.

This machine is manufactured by the M. D. Knowlton Company, of Rochester, N. Y. A Westinghouse motor, which can be connected to the lighting circuit, provides the power. It is mounted on the top of the frame, and is geared direct to the machine for individual drive. The stayer can be mounted on casters, so that it can be easily moved about the factory to any desired place.

A feature of the machine which is of special interest is the Knowlton safety device, which replaces the old-style driving link in the machine head. It serves a double purpose—of a pressure transmission and as a protection to the operation. The safety device is designed in such a manner that when the head is

lowering there is no driving connection until the head comes within a distance of approximately 5/32 inch of the anvil.



Knowlton Corner Staying Machine

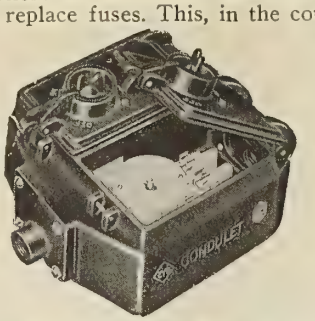
Any obstruction thicker than this prevents the device from locking and so exerting pressure. Thus this insures that it is impossible for the operator to be injured between the head and the anvil.

Last Word in Small Motor Switches

Herewith are shown illustrations of two switch Condulets of the ZY series—the latest additions of the large family of conduit fittings manufactured by the Cross-Hinds Company, of Syracuse, N. Y. As safety-first fittings, ZY Condulets seemingly leave little to be desired. It is claimed for them that they protect the switch operator and the person renewing fuses from shock; they cannot be operated by accident; they withstand the roughest usage; water will not drain into them, and it is impossible for lint or other inflammable particles to lodge upon the current-carrying parts, and thus create a fire hazard.

Both the body of the Condulet and its cover are cast iron. Inside is a combined 20-ampere snap switch and fuse block. The switch is externally operated, and its handle interlocks with the latch of the door in such a way that the latter cannot be opened when the switch is in the "on" position. As a result of this arrangement, the circuit is dead when the door is open, and fuses can be replaced without danger of shock or short circuit.

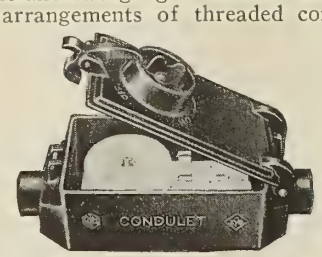
As the machine operator or any other person not skilled in electricity can change fuses with perfect safety in ZY Condulets, their use prevents all the loss in productive time, which is unavoidable where an electrician must be sent for to replace fuses. This, in the course



Type ZYU Two-Gang Through Feed

of a year, means a considerable saving in the operating time of the average mill.

The manufacturers list ZY Condulets in one and two-gang forms and in sizes and arrangements of threaded conduit



Type ZYC One-Gang Through Feed

hubs to meet various conduit wiring arrangements. They have also issued a folder on ZY Condulets which they will mail free to any address, upon request.

Shipbuilding Course Inaugurated at Lehigh

In order to meet the demands in shipbuilding and future demands in ocean transportation, a three-year course in ship construction and marine transportation will now be a part of the curriculum at Lehigh University. The course, which will include naval architecture, marine engineering and foreign commerce, began September 12, and will have the same entrance requirements and the same basis of mathematics and sciences as the other engineering courses.

President Hurley Suggests Miniature Boats as Toys

With a view to instilling the juvenile mind with the idea of a merchant marine, manufacturers have notified President Hurley of the Shipping Board that they will follow his suggestion of manufacturing millions of miniature boats. The boats will be made up in such a fashion as to bring home as forcibly as possible to the youngsters the plan of building up a great merchant marine.

New Ruling of War Trade Board

Under a ruling by the War Trade Board no vessel under the American flag will get bunker coal unless her wireless apparatus is so fitted that messages cannot be sent without the knowledge of the master. The master is held responsible for seeing that no message is sent to the enemy, that no reports are made of vessels sighted or of any weather conditions experienced, and that no messages except for emergencies can be sent within 200 miles of England, France, Portugal or Italy.

SHIPYARD NOTES

Changes and Extensions at the New Jersey Shipbuilding Yards

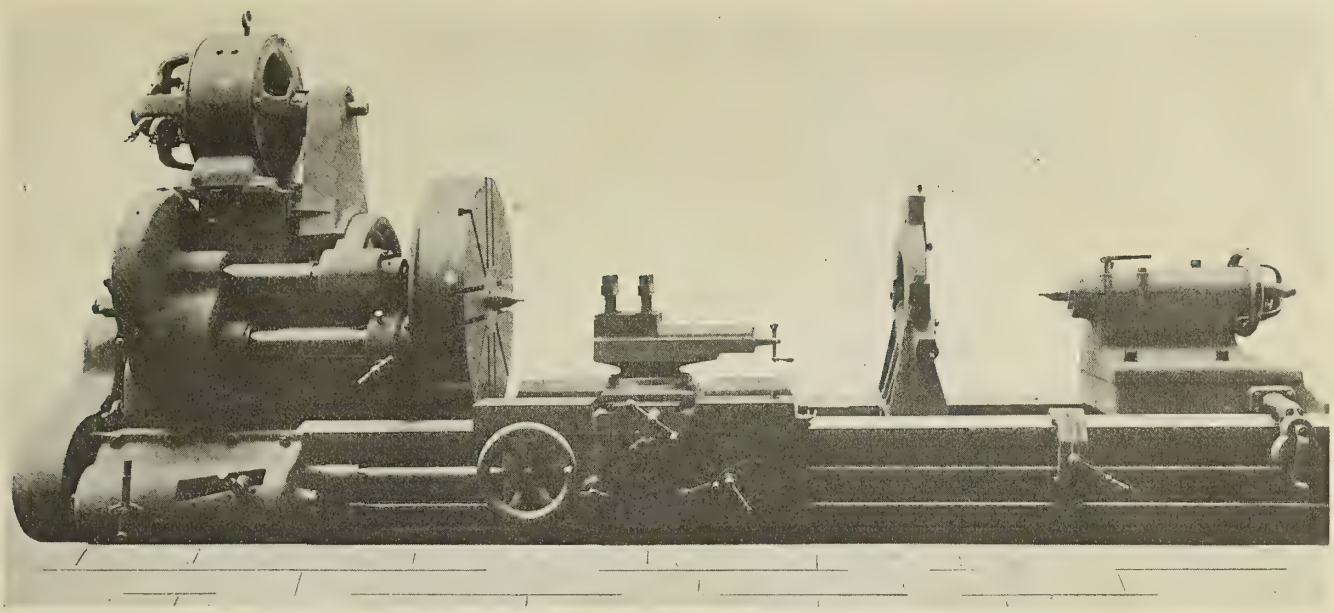
The Emergency Fleet Corporation, Philadelphia, Pa., has formerly taken over the shipyards of Pusey & Jones, Wilmington, Del., at Gloucester City, N. J., heretofore known as the Pennsylvania Shipbuilding Company and the New Jersey Shipbuilding Company, respectively. It is understood that several changes and extensions are contemplated to facilitate operation and increase the present speed of production. In this connection, M. E. Davis will remain as general manager of both plants. For several months past J. G. Barstars, treasurer of both yards, has been appointed on the board of directors of the company by the Government. Hugh V. Ramsey is general superintendent of both shipyards. In connection with this action of the Emergency Fleet Corporation the following changes have been announced: George W. Beatty to be assistant superintendent of the yard of the New Jersey Shipbuilding Company; Frank Breckenridge, assistant superintendent of the yard of the Pennsylvania Shipbuilding Company; S. E. Krause and S. E. Southard, assistant and private secretary, respectively, to the general manager. George S. Hoell, Philadelphia, has resigned as office manager of the yards, and will be succeeded in this position by Mr. Whittison. Mr. Hoell was one of the officials of the Pennsylvania Shipbuilding Company when first organized, and will become associated with the Delaware River Dredging Company.

Loss by Fire

Following the loss by fire, September 11, of the plate and angle shop and electric power plant, located at the lower end of the main yard of the New York Shipbuilding Company, Camden, N. J., plans are under way for replacing the structures. The loss, including equipment, is estimated at over $300,000. This section of the plant has been devoted to the production of torpedo boat destroyers for the Government, the shops being employed for the manufacture of steel and iron parts; at the time of the fire five such boats were in course of construction, and owing to the extensive facilities now provided at the plant there has been but slight delay in the continuing of construction. New torpedo boat destroyers are being completed rapidly at the works, launchings having been made about every week during the past month. The yard is also building a number of colliers as well as vessels of other types.

New Construction Under Way

The Union Shipbuilding Company, Fairfield, Md., has plans under way for the construction of its proposed new shipbuilding plant on water-front property recently acquired in this section. The initial works will consist of from six to ten shipbuilding berths, with machine shops, foundry, forge, forge shop, boiler plant, mold loft and other departments. The buildings will be of steel and concrete construction, and fully equipped for the production of wooden vessels. The plant will be operated in conjunction with the other works of the company in this district.

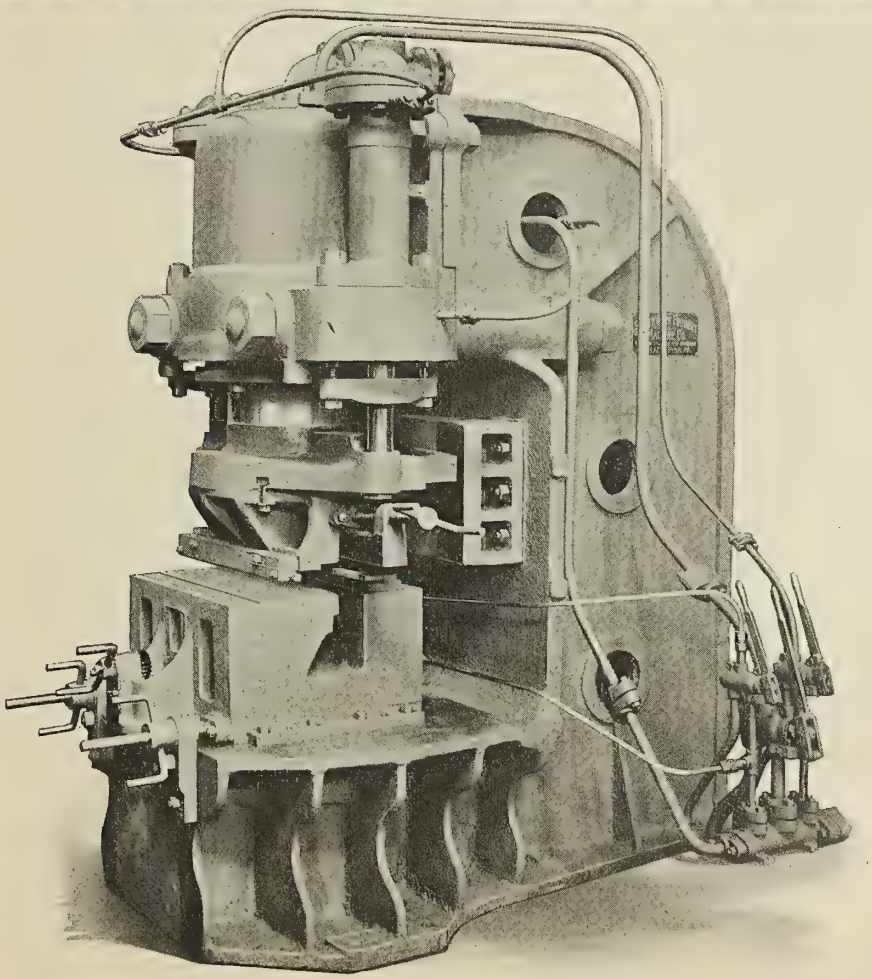


Heavy Lathe for Work in Marine Shops and Shipyards

Fifty-Inch Swing Lathe for Propeller Shaft Work

The Pittsburgh Machine Tool Company, Braddock, Pa., is marketing an exceptionally rigid lathe, furnished with either motor or belt drive, for heavy work in the shipyards. The head stock of the tool has a ratio of 68 to 1, the front spindle is 8 inches diameter and 12 inches long, the gear face is exceptionally wide, and the head is built with either cast iron or steel gearing, as preferred. The tail spindle and center are very large diameter. The carriage is designed with the idea to easy handling, and is therefore very sensitive.

The apron is of double plate construction with all studs double bearing, the rack pinion stud having an inside support. All gears are steel in the apron, the shafts are case-hardened and ground, and the carriage is made with a quick return and motor driven, if so desired. These lathes are constructed in any length of bed desired, and altogether offer a wide range of service in marine engine or shipyard work.



Hydraulic Plate Joggling Press with Removable Section in the Base

Plate Joggling Press for Use in Shipyards

The Southwark Foundry & Machine Company, Philadelphia, has recently placed on the market a new 200-ton plate joggling press, the equipment of which includes special dies consisting of a main lower die section and an upper pressure die, which is fastened to the ram, the lower die section being cut away to permit channels and bulb angles to pass through at right angles to the horizontal centerline of the machine.

The upper die is equipped with an adjustable slide and a taper wedge for changing the amount of joggle. The dies are arranged to joggle both right and left hand and have a capacity for 12-inch channels or equivalent sections.

The lower dies have three vertical rams and one horizontal one which is employed for clamping the work. Two of the vertical rams are operated by hydraulic pressure and are used to hold the material straight while joggling is being done, as well as acting as stripping dies when the pressure is relieved.

The center ram is operated by a wedge and handwheel at the front of the machine. The whole lower die block has a horizontal adjustment through handwheels and screws to center of the die for different classes of work.

The rams operate under a hydraulic pressure of 1,500 pounds per square inch, and the clearance from the face of the ram to the table is 39 inches.

The machine has open-hearth steel castings for the main top and bottom openings and the main ram, which is 20 inches in diameter with a 12-inch stroke, is equipped with hydraulic side pullbacks.

A removable section in the base of the

machine enables it to be used as a manhole punch. When handling this class of work it is nominally operated direct from a 1,500-pound pressure line, but may be operated with a low pressure filling system if desired. The operating valves are placed so as not to interfere with the operator's view of the work. The throat of the machine is 30¼ inches deep and the table 4 feet square. The floor space occupied by the machine is approximately 8 by 10 feet.

War Trade Board Rulings

The War Trade Board announce that a general import license, to be known as PBF No. 26, has been issued, covering the importation of surplus ships' stores and supplies, which the Bureau of Transportation of the War Trade Board may order to be removed from vessels in United States ports.

Walworth Company Adopts "War Finish" Wrench

With the idea of releasing labor and conserving material and fuel the Walworth Manufacturing Company, Boston, Mass., at the urgent request of the War Industries Board will discontinue the manufacture of the 6-inch genuine Walworth Stillson wrench, also the manufacture of the wood-handle genuine Walworth Stillson wrench in all sizes (making only the steel handle); and have adopted the "War Finish" as a standard finish for genuine Walworth Stillson wrenches for the duration of the war.

No change whatever will be made in patterns of quality of material or workmanship in the wrench proper. A tag will be attached to each wrench giving the reasons for the change to "War Finish" standard.

Although the "War Finish" wrench presents a rougher appearance, it is the same sturdy, dependable tool that has been made by the Walworth Manufacturing Company for nearly fifty years.

New York University Establishes New Course in Marine Insurance

In preparation for trade conditions following the war the School of Commerce of New York University has announced in its curriculum this fall a course on Marine Losses and Average Adjustments. The course will be given by Hugh A. Mullins, manager of the loss and adjustment departments of Parsons & Eggert and Marsh & McLennan. It will be part of the foreign trade curriculum of the Wall Street Division, and the classes are expected to be as large as those in the Marine Insurance course, which was inaugurated last year and will be continued during the coming sessions, with William D. Winter, third vice-president of the Mutual Insurance Company, as instructor.

Prof. A. W. Taylor, director of the Wall Street Division, upon explaining why it was considered expedient to establish this course said:

"Marine insurance is a vital factor in the development of our merchant marine. It is quite possible for marine insurance companies to discriminate against vessels belonging to foreign countries, and it is asserted by some that the inferior classification given to American vessels by foreign companies in the 60's and 70's, with the consequent higher rates demanded, was an important factor in the destruction of the American merchant marine. Now that we are building ships again and are extending our credit in foreign countries, there has come a rapid increase in the number of marine insurance companies on this side of the water to meet the new situation, and there is a demand for men trained in this branch of insurance.

"The business of marine insurance is divided into two more or less separate divisions, first that of underwriting, which involves the consideration of the risk to be taken, and, second, that of adjustment and losses, and, in short, the adjustment of losses is quite as important as the taking of the risk. Notwithstanding the fact that marine insurance is the oldest form of insurance, it is probably the least known in this country."

An extended series of lectures has been prepared for this course.

Shipfitters' Classes at Franklin Union, Boston

Walter B. Russell, director of the Franklin Union, Boston, has issued circulars announcing the reopening on October 22, 1918, of the classes in Ship Design and Calculations and Blue Print Reading for Shipfitters.

The class in Ship Design and Calculations is starting its fifth regular season, and will be conducted on Tuesday and Thursday evenings of each week to April 17, 1919.

The course covers the preparation of a set of ships' lines, midship section and general arrangement plans, areas and centers of plane and solid figures, Simpson and trapezoidal rules, weights and moments, displacement, block coefficient of fineness, center of buoyancy, transverse and longitudinal metacenters, trim of ships, etc.

Following the precedent adopted last season, the course will be open to women desiring instruction along the above lines.

The class in Blue Print Reading for Shipfitters, which was started last season, will be conducted on the same evenings as the class in Ship Design and Calculations.

This course provides instruction for men actually engaged in shipfitting and allied trades, and covers the definition of the various conventions used on ships' plans, the sketching of connections of structural ship work and the practical interpretation of working drawings.

American Screw Propellers

The American Screw Propeller Company of Philadelphia, designers of screw propellers and propulsive experts, announce that they have designed the propellers for over 450 vessels now building and on contract. This company's clientele now consists of nearly fifty of the largest American and Canadian shipyards, ten prominent steamship lines, eight naval architectural and engineering concerns, and a number of engine builders. They are also designers of marine propeller wheels for all classes and types of vessels.

RECENT LAUNCHINGS

The troop ship *Saccarappa*, the second of Hog Island's large fleet of cargo carriers and troop ships, was successfully launched on August 24. The *Saccarappa* was given her name by Mrs. Woodrow Wilson.

The mine-sweeper and mine-layer *Sanderling* was launched early in September at the Tebo Yacht Basin, Brooklyn, of the Todd Shipyards Corporation. Miss Dorothy Baine was the sponsor. The vessel is 180 feet long, 35½ feet beam, 18 feet deep, with a speed of from 14 to 15 knots. She carries oil, being an oil burner, and has also wrecking appliances. The contract for the vessel was signed on March 28 last year, and the keel was laid about June 1. This is the fifth vessel of this class launched at the Tebo Basin. Three have been delivered to the Government out of a total of the ten ordered.

The steamer *William L. Stead*, a vessel of 13,665 gross tons, built for the Pan-American Petroleum & Transportation Company, was launched on September 2 at the Fore River yards of the Bethlehem Shipbuilding Corporation. The steamer was named by Mrs. Paul H. Harwood, wife of the president of the company, for William L. Stead, superintendent of the Mexican Petroleum Company of California.

The vessel slid from the ways with such momentum that she struck on a ledge on the opposite bank of the river and slightly dented a plate.

PERSONAL

Charles Skentelbery, marine superintendent of the New England Fuel & Transportation Company, Boston, Mass., for the past eleven years, has resigned his position in that company and has associated himself with the Warren Transportation Company, 35 Congress street, Boston, Mass., as general manager.

G. A. Tomlinson, federal manager of the New York & New Jersey canals, has been appointed director of the Division of Inland Waterways, with office in Washington, D. C.

The Weiss Engine Company, executive offices, Edison building, 72 West Adams street, Chicago, announce the election of the following officers: President, Lucien I. Yeomans; vice-president, Carl W. Weiss; vice-president and general manager, Charles B. Page.

A. H. Morner, general manager of the Bolinder's Company, whose New York offices are at 30 Church street, New York, recently arrived from Sweden to take charge of the American business.

A. J. Barnes has been appointed export manager of the Shepard Electric Crane & Hoist Company, with headquarters at Montour Falls, N. Y. Mr. Barnes will also continue to be director of publicity.

OBITUARY

Anthony Weston Dimock, for many years well known in New York City as financier, explorer, steamship owner and author, died suddenly on September 13 at his country home in Happy Valley, Catskill Mountains. Mr. Dimock was born in Yarmouth, N. S., August 27, 1842.